IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF NORTH CAROLINA

STUDENTS FOR FAIR ADMISSIONS, INC.,	*	
Plaintiff,	*	Case No. 1:14CV954
vs.	*	
	*	November 17, 2020
UNIVERSITY OF NORTH CAROLINA, et al.,	*	**Volume 6**
	*	**Pages 926-1115**
Defendants.	*	

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EXPEDITED TRANSCRIPT OF TRIAL
BEFORE THE HONORABLE LORETTA C. BIGGS
UNITED STATES DISTRICT JUDGE

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I N D E X

P R O C E E D I N G S

THE COURT: Good morning. Are there matters that we need to discuss before we proceed this morning?

MS. FLATH: Not from the UNC Defendants, Your Honor.

THE COURT: All right. Then if you would call your next witness, please.

MS. FLATH: Thank you, Your Honor. And Lara Flath from Skadden for the UNC Defendants.

THE COURT: Thank you.

MS. FLATH: The UNC Defendants call Caroline Hoxby, who will be appearing remotely.

THE COURT: Yes.

CAROLINE HOXBY, DEFENDANT UNC WITNESS VIA VIDEO, SWORN

DIRECT EXAMINATION

BY MS. FLATH:

THE WITNESS: I have to say the audio is a little bit faint for me, so I'm having a little bit of difficulty.

Q. Good morning, Professor Hoxby. Can you hear me?

A. Yes, I can hear you very well.

Q. Excellent. You will have the microphone now that I'm speaking from and when Mr. McCarthy speaks to you later today.

Can you please state your name and position of employment for the Court?

A. My name is Caroline Minter Hoxby, and I am a Professor of Economics at Stanford University.

Q. And have you been retained by UNC as an expert in this case?
A. Yes, I have.
Q. Professor Hoxby, did you prepare a set of demonstrative slides to assist you in providing your testimony?
A. Yes, I did.

MS. FLATH: Your Honor, this is DX506. We provided a hard copy, as well as an electronic copy for the court reporter.

THE COURT: Thank you.

Q. (By Ms. Flath) Professor Hoxby, if you'll turn to Slide 2.

Can you briefly describe your educational background?
A. Yes. I was an undergraduate student -- well, I was a high school student at Shaker -- I was a high school student at Shaker Heights Public High School outside of Cleveland.

And then I was an undergraduate at Harvard University from 1984 to 1988. And then I got a master's degree at the University of Oxford in England from 1988 to 1990. And then I got my Ph.D. at MIT, the Massachusetts Institute of Technology, and that was another four years. So I got my degree in 1994.
Q. And your Ph.D. is in economics, right?
A. That is correct. All of my degrees are in economics.
Q. After you received your Ph.D., where did you work?
A. I was hired by Harvard University as an assistant professor, and I remained at Harvard University for 13 years,

first as an assistant professor, then as an associate professor, and then finally as a full professor and a chair full professor as the (indiscernible).

(Court reporter requests clarification.)

Q. Professor Hoxby, we're having just a little bit of difficulty with the audio.

Can you please repeat the title of your position at Harvard?

A. I was the Allie S. Freed professor of economics at Harvard University.

Q. After --

A. Would it -- I'm sorry. I don't mean to interrupt, but do you think it would help if I put on a closer microphone? Would that help the problem?

Q. If you are able to do that, that might help. Thank you.

A. Is this better, Ms. Flath?

Q. Let's try it, Professor Hoxby. We'll certainly do what we can with the audio.

After you left Harvard, what position did you hold at Stanford?

A. I apologize, but I think that made it worse, so I'm taking away the headphones and microphone. We'll keep trying.

After Harvard, what position did I hold, was that the question?

Q. That's right.

A. So in 2007, I moved from Harvard University to Stanford University where I currently I am a professor of economics.
Q. What's your general field of specialization within economics?
A. I specialize in the economics of education, especially higher education but not exclusively higher education, and I'm probably the -- maybe the first economist in the United States to be identified with that field, but I have been now for my entire adult career.
Q. Do you teach undergraduate and graduate courses in economics?
A. I do. I traditionally teach an undergraduate course called the Economics of Education -- some graduate students also take that course; I teach Labor Economics particularly to graduate students and Ph.D. students; and I teach Public Economics to graduate students or Ph.D. students.
Q. Is it fair to say you've been published in many economic journals?
A. Yes, I think that would be fair to say.
Q. And have you also edited several books relating to the economics of education?
A. Yes. And, in particular, I recently edited a couple of volumes that included articles on (indiscernible).
(Court reporter requests clarification.)
THE COURT: Let's stop just a moment. Let's stop just

a moment.
Q. (By Ms. Flath) Professor Hoxby, we're having just a little bit of trouble hearing you with the pace of your speech over the audio connection, so we're just checking to see if we can do something on the technical side.
(Pause in the proceedings.)
Q. So, Professor Hoxby, I think -- let's try to have you speak just a little bit more slowly, and hopefully that will help the connection for the court reporter.
MS. FLATH: Does that work, Your Honor?
THE COURT: We can try that.
Q. (By Ms. Flath) Professor Hoxby, I believe you were saying that you have recently edited a couple of articles. Was that right?
A. I was saying that I had recently edited a couple of volumes, books, that contain -- each one of which contains numerous articles or papers on the subject of higher education, for instance, how students choose colleges, what their -- what value they get out of colleges, and how colleges respond to environment, for instance, the financial crisis that affected many (indiscernible).
(Court reporter requests clarification.)
Q. Professor Hoxby, I think we were doing a little bit better, except for the end of your sentences and the end of your words. I realize that's a challenge, but if you can repeat the very

last phrase you provided.
A. It was that I said I had edited a volume that included articles on how colleges had responded to the financial crisis and the Great Recession because that was a series of events that had a lot of impact on colleges, universities in the United States.
Q. Thank you.
Very briefly, what are just a few of the awards and honors you have received for your research?
A. Well, I'm a member of the American Academy of Arts and Sciences. I am a member of the British equivalent of the American Academy of Arts and Sciences. I received the Smithsonian's award for ingenuity, which is essentially an award for very original and thoughtful research. I have the Fordham award for being the best economist of education, educational researcher in the United States (indiscernible).
(Court reporter requests clarification.)
Q. Professor Hoxby, if you could just slow down a little more. I'm sorry to have to interrupt you.
A. I received the Fordham award for excellence in education research. I have awards from the National Tax Association. I have a lot of awards, so perhaps we don't need to cover them all.
Q. Thank you.
Have you served on the National Board for Education

Sciences?
A. Yes, I did. I served two full terms on the National Board for Education Sciences.
Q. Who appointed you to that board?
THE COURT: Let -- let us talk to Efren just a minute to see if he can do anything that helps.
MS. FLATH: That would be great.
Q. (By Ms. Flath) Professor Hoxby, we're going to work on seeing if we can improve the audio connection.
(Pause in the proceedings.)
Q. (By Ms. Flath) Professor Hoxby, we're just working on seeing if we can improve the bandwidth to help with the audio connection for those in the courtroom.
A. Ms. Flath, do you think it is possible that the problem is on my side and that I could do something to improve?
Q. At the moment we don't think so, but thank you.
(Pause in the proceedings.)
Q. (By Ms. Flath) Professor, we think it will just be a few minutes.
(Pause in the proceedings.)
MS. FLATH: Thank you for your patience, Your Honor. A new world for all of us.
THE COURT: For all of us.
Q. (By Ms. Flath) Professor Hoxby, can you still hear me?
A. Yes, I can hear you perfectly.

Q. I think that's a little bit better. So thank you for your patience, and hopefully this will help our day go a little smoother.

I believe I was asking you who appointed you to the board -- to the National Board for Education Services [sic].

A. Sciences, the National Board for Education Sciences.

Sorry to correct you, Ms. Flath.

Q. Thank you.

A. Well, it's a presidential appointment.

Q. Thank you.

Which president appointed you?

A. George W. Bush, but I continued to serve part of the time under President Obama.

Q. Thank you. Now, you're the program director for the Economics of Education Program for the National Bureau of Economic Research; is that right?

A. That's correct.

Q. And what is the Economics of Education Program?

A. The National Bureau of Economic Research is an organization that takes the leading economists from all over the world and puts them together into one meta organization. Almost think of it as a meta economics department that combines all of the economists in the world, especially those from the United States and Canada, but not exclusively people from the United States and Canada.

And I am the head of the Economics of Education Program at the National Bureau of Economic Research. It has a little fewer than 200 members, and they are economists who specialize in education research from around the world, as I mentioned.

Q. Thank you. Let's turn to the questions you were asked to provide -- to address in your work here.

Turning to Slide 3 of DX506, at a high level what questions were you asked to address in providing expert testimony in this case?

A. Well, the first question that I was asked to address is whether the Plaintiff's allegations regarding UNC's admissions process, especially the allegation of whether race/ethnicity were dominant factors in the admissions process -- whether those allegations were, in fact, true.

Q. What else?

A. The second question that I was asked to address is whether there were potential race-neutral or race-blind alternatives to the current admission process that would allow UNC to attain its current levels of racial and ethnic diversity and academic preparedness.

Q. And what was the third topic you addressed?

A. I was asked to respond to the opinion of expert Peter Arcidiacono and Richard Kahlenberg.

Q. Thank you.

Turning to Slide 4, at a very high level, what did you

conclude with respect to the first two questions you were asked to consider?

A. My first conclusion was that -- I did careful empirical analysis. I established that UNC's admissions decisions appeared to be fully consistent with the holistic admissions process and that UNC's processes could not be explained by a formula based on verifiable variables. In other words, UNC's process was not (indiscernible).

(Court reporter requests clarification.)

Q. Professor Hoxby, could you just repeat the last word?

A. I -- in other words, UNC's process does not appear to be formulaic.

Q. Thank you.

What else?

A. In addition, on -- with regard to the first question, I concluded that race and ethnicity are not dominant factors in the UNC admissions process.

Q. Thank you.

What was the second opinion at a high level that you reached?

A. With regard to the second question, I conducted really exhaustive simulations of race-neutral alternatives, well more than a hundred, trying to address all of the suggestions made by Plaintiffs about what might be plausible race-neutral alternatives and trying to bring the data to analyze each one

of the alternatives as well as I could, including some alternatives that they did not suggest but that I thought would test the limit of what was possible under a race-neutral alternative.

And after conducting all those simulations and trying to ensure that the conditions were as positive as possible for the race-neutral alternatives -- in other words, using really generous assumptions that would favor the alternatives -- I concluded that in no case could one of the race-neutral alternatives allow UNC to attain its current levels of racial and ethnic diversity as well as academic preparedness.

Q. Thank you. And thank you for the pacing. I think that's working a bit better for our court reporter. So much appreciated.

Let's turn to your first opinion that you just discussed.

Plaintiff has alleged in the complaint that although UNC claims to use race and ethnicity as only one of many factors in a holistic system, statistical evidence establishes that race is a dominant factor in admissions decisions.

If that allegation is correct, what will the data show you in terms of a formula?

A. The data would show me two things at least. The first is that a formula or a regression -- multiple regression, which is what we do in statistical analysis -- that multiple regression would reveal to me that a model or regression could explain

most of the decision between admissions and rejection. So that's the first thing that I would be able to see from the regression analysis.

The second thing that I would be able to see from the regression analysis is that when I decomposed the explanatory power of the regression model, a lot of the variation would be explained by race and ethnicity.

Q. Thank you.

Let's turn on Slide 6 to some of the regression models that you created using the UNC admissions data.

What does this slide show with respect to the regression models you built to assess the question of whether the UNC admissions system is holistic or formulaic?

A. This table shows nine different models, starting with a model at the top which is very barebones because it only includes SAT scores, ACT scores, and race and ethnicity factors.

What -- what I'm doing as I work my way down the table is I'm adding more and more variables to the model. For instance, in Row 2 I'm adding subscores on the SAT and ACT. Then I'm adding a student's class rank in high school and a student's high school GPA. Then I add a student's sex or gender. Then I add whether the student is a resident of North Carolina, which is important because UNC is a state public flagship university. Then I add UNC's -- whether the student met UNC's minimum

coursework requirements and, for instance, whether the student was also a child of a faculty or staff member. Perhaps I don't need to cover every variable that I added, but those are important.

The next row I add is whether a parent was an alum of UNC and whether the student applied in the early action phase of UNC's admissions process or whether the student applied -- as opposed to the regular admissions phase. Then I add parents' education, foreign citizenship for the student, and whether the student applied using a fee waiver. Fee waivers are given to low-income students, so that fee waiver variable would indicate a student himself or herself low income.

And then in the very final row, I add the within-high school GPA rank. This is added for a special reason. It's because at the very end of the UNC admissions process, there is a phase called school group review in which admissions officers look at a student in a sort of listing compared to his or her high school classmates who also applied to UNC. And the way in which they are listed is in order of their high school class rank with the higher ranked students appearing at the top. This school group review process, therefore, does make use of within-high school class rank. So it could be considered an important factor in the admissions process at UNC.

Q. Thank you.

In performing your analysis and building your models, how

did you determine which variables to include in the model reflected in Rows 1 through 9?

A. Well, anytime we build a model, what we are attempting to do is to replicate or understand the behavior of actual human beings. That's the goal of all model building of this work that I conduct. So the way I look at it is what does an admissions officer see? What does an admissions officer consider? So I need to know something about that process, and I also need to know what sort of data or variables they would be seeing, viewing when they see a student application. I know that many of the variables that are on this -- that are in my models are seen by admissions officers and are considered by admissions officers. So that's my very first criterion.

I also want to take account of any other variable that an admissions officer might consider but might be more (indiscernible).

(Court reporter requests clarification.)

Q. What was that last phrase? You cut out. You were doing very well until that last phrase. Right after "I also want to take account of any other variable that an admissions officer might consider."

A. Right. I want to take account of any other variable that an admissions officer might consider, even if it -- even if it is not something that would appear on the front page of the application. For instance, whether the student is -- has an

alumni parent or not, it's not obvious that admissions officers would take account of that, but it is certainly possible that admissions officers would take account of it.

Q. Thank you.

Professor Arcidiacono testified about your decision to exclude the UNC ratings variables.

Why did you make that decision?

A. I excluded the UNC ratings variables because they are evaluative variables or what an economist would call "endogenous variables." Endogenous means that the variables are determined within the process itself, within the admissions process itself.

And it may help if I give you an example of other endogenous, or evaluative, variables that are more familiar to people. For instance, imagine that we have some people who show up at a hospital and they're all having chest pains, and they go in for an evaluation in the emergency room. At some point in that evaluative process -- excuse me -- that evaluative process, a nurse or a physician starts to write down an intermediate evaluation of what -- of how the person is faring with their chest pains. That is part of the evaluation process.

So if we found that the nurses and the physicians sent some people straight to the ICU to get triple bypass surgery and we saw that they sent some people home with aspirin, we might be

able to predict who went to the ICU and who was sent home with aspirin by looking at that intermediate evaluative variable where the physician says this person is having a terrible heart attack or this person seems fine and really is just having, you know, a digestive instance.

Okay. So that's -- that intermediate variable might do a good job of explaining why some people go to the ICU and why some people get sent home with aspirin, but it's very important to realize that it's not really something that the patient had coming in to the emergency room. That's not something that is -- that's not something that's a factor that everyone could look at the same way and say is a verifiable objective factor. It is, in fact, an evaluative, or endogenous, variable that is determined in the middle of the process of evaluation at the hospital.

If we go back to the ratings variables at UNC, we will see that they are very similar to the hospital example that I just gave. The ratings variables do not come in with the student's application. They are intermediate variables that are determined within the application process as a trained admissions officer looks at the student application and makes some decision about how to evaluate this student. So, therefore, we have the same problem that a student who gets high ratings will be more likely to get in and a student who gets low ratings will be less likely to get into UNC, but those

are not verifiable objective factors. And statisticians are trained not to put that kind of variable into a multiple regression. It's an elementary mistake.

Q. Thank you.

Now, the chart on Slide 6 has a column for R-squared with a range of valuables for your various models. Before we turn to the specific interpretation of R-squared, let's talk about the concept of it generally.

Do you recall Professor Arcidiacono testifying that a pseudo R-squared of 0.2 to 0.4 is considered an excellent fit?

A. I do recall that testimony, yes.

Q. So let's turn to Slide 7.

And do you recall that Professor Arcidiacono prepared a slide referencing a particular test by Professor Dan McFadden?

A. Yes, that's correct.

Q. And what's your response to that citation?

A. Well, both R-squared and pseudo R-squared are measures of the goodness of fit of a model, and pseudo R-squared is designed to be analogous as possible to R-squared, the difference being that R-squared is for a linear model in which the outcome is something that moves continuously.

For instance, in the case of admissions, a linear model would be a model that fits a student's probability of admission. For instance, I might have a 24 percent probability, 25 percent, 26 percent, 27 percent. We can see

that variable moves continuously.

In contrast, if we are trying to study the admissions rejection decision, that's a binary model, a yes-no type of model. Either the student gets admitted or the student is rejected. So that's a nonlinear model.

And then we can get even much more complicated and have something called a multinomial model, which just means multiple choices.

And Daniel McFadden in his paper was seeing the introduction of the rapid transit system, or BART system, in the Bay area and in -- in that -- in those circumstances, there were many choices. A person could take the BART; a person could drive; a person could bicycle; a person could walk. There were many, many choices in the model that he was analyzing, a very complex model. Essentially, the more choices you have in a multiple-choice model, the harder it is to get a R-squared or a pseudo R-squared that is (indiscernible).

(Court reporter requests clarification.)

Q. Was the last word you said "high"?

A. High, yes.

Q. Thank you. Please continue.

A. The reason why pseudo R-squared will be lower in a model that has more choices is that the choices interact with one another in a complicated way. Let me give you an example.

For instance, in the model that Daniel McFadden was

considering, if it is a rainy day, people might be less likely to walk; they might be less likely to bicycle; and they might also not prefer to take the BART because they have to stand at a -- you know, at a BART station in the open rain.

So that's -- I've just given you one example of a factor that can have quite complicated influences in a multiple-choice model, but you can start to imagine all kinds of factors in your own lives that might affect which mode of commuting to use every day.

So the result is in a multi-quiz model, pseudo R-squared or the explanatory power of the model will tend to be quite low because there are so many complicated factors and because the choices interact with one another in a complicated way.

So then going back to Daniel McFadden's words, what he was saying was that in the context of the model that he was considering, this transportation choice model, is pseudo R-squared between .2 and .4 might be considered an excellent fit for that model in those circumstances, but we are not in those circumstances with the UNC admissions decision.

Q. Thank you.

Now let's turn back to the UNC admissions process.

Looking at Model 9, which was the last row of the chart we discussed on Slide 6, what was the R-squared?

A. The last row, Model 9, which I regard as my preferred model because it includes all of the factors I think an admissions

officer might consider, the R-squared -- or pseudo R-squared is .428 --

Q. And turn --

A. -- which suggests --

Q. Go ahead.

A. -- which suggests that the model explained about 42.8 percent of the admission rejection decision.

Q. And is that indicated on your chart on Slide 8?

A. Yes, it is. Slide 8 shows that 42.8 percent of the admissions decision is explained by my preferred model.

Q. And what does that tell you about whether the UNC admissions process is holistic or formulaic?

A. It says that the admissions decision must be holistic and cannot be formulaic.

I think it's important for people to focus on the other side of the pie chart, the blue side of the pie chart. Often it's easy for people to get caught up in the part of the decision that is explained by the model and forget about all of the parts that are not explained by the model; but that part that's not explained is important. In this case, it is the majority of the admissions decision, 57.2 percent of the admissions decision.

And the reason I say it's important is that it is not that the admissions decision is somehow absent in that part. It isn't absent. This isn't something that isn't happening. It's

something that's happening, but we, as statisticians, econometricians, do not know what is happening in that part. It's that the admissions officer is looking at the whole application, looking over that -- all of the material that's there -- the essays, the letters, the personal statement, the context for the student -- and that is what is going into that 57.2 percent. So it may be not observable by the statistician, but that doesn't mean it wasn't observed or considered carefully by the admissions officer. And so that 57.2 percent shows us that most of the process must be holistic.

Q. Holistic; is that right?

A. That's correct.

Q. Thank you.

Let's turn now to the role of race within the admissions process and Slide 9.

You mentioned decomposing a model. In your opinion, what is the proper econometric method to answer the question of what role a specific factor plays in UNC admissions decisions?

A. The Shapley decomposition was invented by Shapley in the 1950s as a method to demonstrate which factors are playing an important role in a model. The Shapley decomposition decomposes R-squared or pseudo R-squared into (indiscernible).

(Court reporter requests clarification.)

Q. What was the last word? Into?

A. Buckets. Buckets or bins. Shares, I suppose you could

say.

So the Shapley decomposition takes the explanatory power of the model and puts it into buckets for various factors. For instance, race and ethnicity might be in one bucket, and test scores might be in another bucket, high school GPA, class rank could be in yet another bucket.

The Shapley decomposition has been around since the 1950s and is still the only method that satisfies three axioms that statisticians require. Those are efficiency, monotonicity, and equal treatment of factors, and because it is the only way of decomposing R-squared or pseudo R-squared that satisfies those conditions, it has been used since the 1950s straight through to today because it is -- it's really the only decomposition method that is accepted.

Q. If, hypothetically, a factor, or bucket, such as race plays a dominant role in the admissions process but only with respect to a subset of applicants, would the Shapley decomposition reveal this effect?

A. Absolutely. The Shapley decomposition is designed to show the marginal effect of any factor reliably. And if, in fact, the factor was important, even for a subset of applicants, but it was important for them, the Shapley decomposition would definitely show that. And that's because in the Shapley decomposition what's happening is that -- perhaps the best way to think about it is the following:

We take all of the other variables; we hold them constant; and we take in and out some factors. So we take -- we put in an indicator for being African American and then we take it out. Then we rotate all of the other factors and hold them constant at a different level, and we put in African American and take it back out again. Then we do that again, rotating all of the other factors so that they're held constant at a different level. We put in African American. Then we take it out.

And we do that with every possible factor, not, of course, just an indicator for being African American, but every possible factor, all of the possible permutations. That's essentially what the Shapley decomposition does. It says we will hold everything constant at every other possible level, and we will try putting in a factor and taking it back out again.

So as long as a factor is important for any subset of students, it's going to show up in the Shapley decomposition value.

Q. Thank you.

Let's turn now to your opinions after applying the Shapley decomposition to your models in this case.

Does Slide 9 show your analysis of the contribution of race to your Model 9 -- sorry. Excuse me -- Slide 10, Model 9. I'm sorry about messing that up.

A. Yes. Slide 10 does show the Shapley decomposition results, and I think we should probably focus on my Model 9, which is shown at the bottom of the table that's on the slide. You will recall that the pseudo R-squared of that model is .428, showing that the model is explaining 42.8 percent of the admissions rejection decision.

And if we look at the share of the total admissions decision contributed by the race and ethnicity variables all together as the group -- all together as a group of variables, that's 1.2 percent of the total admissions decision, according to the Shapley decomposition.

Q. And after performing this analysis, what is your conclusion with respect to the role of race within the UNC admissions process?

A. My conclusion is that race and ethnicity explain only a very small share of the admissions process, in this case less than 5 percent.

Q. You also performed the Shapley decomposition to look at the impact of test scores within the model; is that right?

A. Yes, that's correct.

Q. And is that shown on Slide 11 of DX506?

A. It is indeed, yes.

Q. What did you conclude from this analysis with respect to the contribution of test scores relative to the contribution of race?

A. I think we should look at Model 9 again, which is the most complex or elaborate model, my preferred model. And you can see that in Model 9, test scores -- those are ACT scores and SAT scores -- explain 9.8 percent of the admissions rejection decision. So in comparison to race and ethnicity, test scores are a more important factor in the admissions decision by several times, but it's also the case that test scores do not explain most of the admissions decision, only about 10 percent of the admissions decision.

Q. Thank you. Now, did you perform additional analyses to test the results of the Shapley decomposition on other models?

A. Yes, I did.

Q. And is that on Slide 12?

A. Yes. Slide 12 contains some alternatives of other modeling choices that seem very reasonable to me. For instance, I think it is reasonable to estimate a separate model for in-state students and for out-of-state students.

Can I elaborate on that?

Q. Please.

A. So the way that UNC conducts admissions, according to my understanding, is that in-state and out-of-state students are considered at the same time by the admissions staff. There is not sort of one room for the in-state students being considered here and the out-of-state students would be considered in a room down the hall with a different admissions staff. They are

all considered together.

So that is a reason for modeling the admissions process as one process, but I think it is fair and reasonable to say that admissions officers may view in-state and out-of-state students quite differently because of the fact that UNC has a requirement to admit a certain percentage of its students from the in-state pool. So, therefore, I did estimate a separate model for in state and out of state.

If I look at the in-state Shapley decomposition, race and ethnicity explain 1.2 percent of the admissions decision. Test scores explain about 15 percent for that in-state group of students. If I look at the out-of-state Shapley decomposition, race and ethnicity explain 5.1 percent of the admissions decision and test scores explain 18.9 percent of the admissions decision.

So we see this same pattern as we saw before when we looked at all of the students together, that race and ethnicity plays a very small role, 5 percent or less.

Q. Now, we talked earlier about whether the UNC ratings variables should be included in the model. Setting aside your position on whether they should be, did you run a model that includes the UNC ratings variables and observe the results?

A. Yes, I did. Even though I do not believe this is a correct model, I did test a model in which all of those ratings variables were included, and I did a Shapley decomposition

using that model as well. So I believe this is the model that is preferred by Professor Arcidiacono.

And in that, if I include all of those ratings variables, then for the in-state students, race and ethnicity explain 1.6 percent of the admissions decision, and for the out-of-state students, race and ethnicity explain 6.2 percent of the admissions decision. So the takeaway is really the same whether or not those ratings variables are included.

Q. Finally, does running the Shapley decomposition on any other version of your preferred model show a different result?

A. No, it does not. I always end up with the Shapley decomposition showing that race and ethnicity explain around 5 percent or less of the decision. And I should say that the final model described on this slide as the multiplicative model is a very complex model. It essentially allows every factor to be considered differently based on the student's race and ethnicity. Let me give you an example so that it doesn't sound like technical jargon.

If I have a student who is Hispanic, say -- this model would allow an Hispanic student's test scores, GPA, class rank -- all of those things to be considered somewhat differently by the admissions officer who knows that the student is Hispanic. This would be a world in which admissions officers try to take race and ethnicity into context whenever they look at any other factor on a student's application.

It's, therefore, a very complex model, and the Shapley decomposition shows that race and ethnicity explain only 5.6 percent of the admissions decision.

Q. Thank you. Now, did you also use a Shapley decomposition on Professor Arcidiacono's preferred models?

A. Yes, I did.

Q. And is that analysis reflected on Slide 13?

A. It is, yes.

Q. Can you walk us through that analysis, please?

A. So Professor Arcidiacono's preferred model, as I understand it, is what he calls Model 4. It is a model that does include those ratings variables, and I performed a Shapley decomposition on that -- on that model.

And when I performed that Shapley decomposition, I saw that for in-state students, 2.7 percent of the admissions decision was accounted for by race and ethnicity; and on the out-of-state students, 6.7 percent of the admissions decision was due to race and ethnicity in Professor Arcidiacono's preferred model.

This might also be a good time to talk a little bit about what is desirable in a model as regards to R-squared.

Q. Did you say R-squared?

A. R-squared.

Q. So Professor Arcidiacono testified that his preferred model, Model 4, both the in-state and out-of-state version, had

R-squared of roughly .7 in state and .5 out of state.

Why doesn't his higher R-squared indicate that his model is a better or more accurate model because of that higher R-squared value?

A. R-squared is not a way of measuring the accuracy of a model, and maximizing R-squared is not a desideratum or goal when we are modeling. Maximizing R-squared is simply not something that we, as serious statisticians, would consider trying to do. In fact, an easy way to maximize R-squared is simply to put a lot of random variables into a regression, garbage variables. With enough random variables, I guarantee that I can create a model that has an R-squared of .99. I just have to add enough garbage. So clearly that cannot be the desideratum.

Instead, what we are trying to do with models is be accurate. That means that the model predicts as well out of sample as it predicts in sample. In other words, I use one sample of data to estimate the model, my model now. Then I take it to another very similar set of data, and I see whether the model still performs well. If it performs equally well in sample and out of sample, then it is an accurate model and predicts well. That is the measure of accuracy. That is our goal.

Q. Thank you.

So we'll turn, I think a little bit later, to a little more

about the concept of accuracy. But to summarize what you've just talked about and testified regarding the Shapley decomposition, what is your takeaway with respect to the role of race in the UNC admissions process?

A. Race simply cannot be a dominant factor in the UNC admissions process because it plays a minor role regardless of which model one uses, whether it is my preferred model -- the pie chart that's shown on the left of this slide -- with 1.2 percent, or we divide that into an in-state and out-of-state version -- that's in the middle pie chart -- where we see 1.2 percent and 6.2 percent, respectively, for in state and out of state, or whether we take Professor Arcidiacono's most preferred model where we see 2.7 percent for in state and 6.7 percent for out of state.

I think the message is the same regardless of these model choices. Race and ethnicity is not playing more than -- it's just not playing a large role across the admissions.

Q. And, Professor Hoxby, did you say model -- "regardless of these model choices"?

A. That's right. Regardless of these model choices, race and ethnicity is not playing a dominant or even close to a dominant role in the admissions.

Q. And when you referred to this slide, were you referring to Slide 14?

A. I was referring to Slide 14. Thank you.

Q. Thank you.

Let's turn now to another analysis that Professor Arcidiacono discussed in his testimony, his decile analysis based on his academic index.

Did you prepare a slide on this?

A. Yes.

Q. And is that Slide 15?

A. Slide 15.

Q. Perfect.

A. Yes, Slide 15. Thank you.

Q. What is the first reason you find Professor Arcidiacono's decile analysis to be misleading?

A. Well, first, I think I should say that it is all based on an admissions index that Professor Arcidiacono invented. I myself don't like to call it the academic index because it's not actually used by UNC, or any other college or university of which I am aware. So I like to think of it as Professor Arcidiacono's index, which is fine, but it's idiosyncratic to him.

Okay. So Professor Arcidiacono creates this index using only test scores and grades. And according to his index, he puts people into decile -- puts students -- puts applicants into deciles according to his index, and each decile contains 10 percent of the student applicants to UNC.

But the thing that's very misleading about this table is

that some of those deciles are very important to the UNC admissions process, and some of them are almost irrelevant to the UNC admissions process.

So, for instance, Decile 10, where students have highest test scores and grades, is very important to the UNC admissions process because so many of UNC's actual admits come from that one decile. And the same thing is true of the deciles just below, Decile 9 and Decile 8. Then there are deciles in the middle where some applicants end up getting admitted, but, by no means, these are not nearly as important to the admissions process. And then those would be Deciles 4 through 6 for in-state students and 5 through 7 for out-of-state students. I tend to call these the on-the-bubble deciles or on-the-bubble students. And that's -- that's a colloquial expression to refer to the fact that these are students who might be tipped just sort of one way or the other way, depending on some small factor, being tipped into the admitted or rejected by some small factor. Deciles 1 through 3 are essentially irrelevant to the UNC admissions process regardless of whether looking at in state or out of state.

Q. Why, in examining whether race is a dominant factor, should you look at -- should you not look at a small subset of admitted students?

A. You do not want to look at a small subset of admitted students, not -- not just for considering whether race and

ethnicity is a dominant factor, but for considering whether anything is a dominant factor. And I think I -- it would help if I gave you an example that's a little bit removed, and then I'll move back to race and ethnicity.

So let's say that a student is a very good violin player and might contribute substantially to UNC's student orchestra. I could find a student who was just on the bubble of being admitted or rejected, really just going back and forth, really close to the edge; and if the admissions officer were to realize that that student was a good violinist, it might tip this student from rejection to admission.

Now, you could say in that one student's case that being a -- that playing the violin was something that determined whether the student was rejected or admitted, and that would be true for that one student, but it would certainly not be true that we would say that UNC's admissions process is dominated by violin playing.

Similarly -- did I -- was I heard?

Q. You're heard.

A. Similarly, we could look at some students who are just on the bubble of being rejected or admitted, and those students' contribution to the racial and ethnic diversity of UNC might be influential when the admissions officer was trying to make that rejection/admissions decision, just tipping them one way or the other way; but that does not mean that race and ethnicity is

playing a dominant role throughout the admissions process with regard to the whole pool of applicants.

That's why we have the Shapley decomposition. It's there to help us. It's a scientific way of understanding the answer to this question.

Q. Thank you.

Can you please explain your last bullet point on Slide 15?

A. So Professor Arcidiacono tends to not consider that there are many factors that may be observable to the admissions officers but are not observable to us, the statisticians. These are -- it's important to realize that we call these unobservable factors, but we don't really mean that they're not observable to anyone. What we mean is that they're not observable to us, the statistician.

So an example would be the quality of the student's writing in his or her essay, or it might be personal qualities that come across in the letters or essays. Those are unobservable factors, and they are important in the admissions process. You'll recall that they explain about 57 percent of the admissions process, unobservable factors.

Well, when we put people into deciles and assume that the only things that matter are test scores and grades, as this decile analysis does, we are essentially pushing those unobservable factors to the side and pretending that they don't exist, whereas they still do exist. In fact, they're more

important than the observable factor.

So when we look at someone, say, in Decile 5 for the in-state students, the student who is admitted from Decile 5 is going to probably be a student whose unobservable factors look unusually good. That's because we know that the students in Decile 5 do not have unusually high test scores and grades, but some of them are still admitted. So it must be that their unobservable factors are what makes them attractive to admissions officers. It could violin playing. It could be their contribution to racial and ethnic diversity. It could be that they're a genius debater in high school. We don't know what it is, but there is something there that the admissions officer can see for the students who are admitted from, say, Decile 5.

And when -- in Professor Arcidiacono's analysis, he tends to treat these unobservable factors as though they didn't exist, as though it were just random which students got admitted from Decile 5. And this is across the board. It doesn't matter what race. There are students who are white and Asian admitted from Decile 5, but many students are rejected from Decile 5 who are white and Asian, so there must be other factors that are unobservable to the statisticians but can be seen by the admissions officers.

Q. Let's turn now to another analysis that Professor Arcidiacono presented in his testimony to the Court: The

calculation of average marginal effect on the probability of admission.

Does Slide 16 present a response to that analysis?

A. It does, yes.

Q. Can you please give us an example of an econometric context in which it makes sense to calculate the marginal effect?

A. Sure. If we were in a randomized control file -- and I think I'm going to use a medical example because that's easier for most people. Say we have a real drug and we have a placebo, and we divide a large sample of people -- let's say 10,000 people get the real drug and 10,000 people get the placebo -- and then we see what happens. That's a classic drug trial.

It's important in this context that people be randomly assigned either to the real drug or to the placebo, and it's also important in this context that I said there were 10,000 people in the drug arm of the trial and 10,000 in the placebo arm of the trial. The reason why both of those things are important is that it is fair to assume, according to the law of large numbers, that the people getting the treated -- the real drug and the people getting the placebo are the same on all other characteristics on average.

Okay. So now I have my drug trial, and I can see how the people with the real drug do in terms of their health, and I can see how the people with the placebo do in terms of their

health. And that is the marginal effect of the drug, holding everything else constant, because I created two groups that were going to be the same. And I might take that marginal effect averaged over the 10,000 people who, in fact, got the drug compared to the people who got the placebo, and that average marginal effect would be a perfectly reasonable thing to report in such a context.

Q. Do you believe that the marginal effect is applicable in the context of UNC admissions decisions?

A. No, it's not in the way that Professor Arcidiacono uses it, and that's for a very simple reason. When we look at UNC admissions data, it is not a randomized control trial. The data are not generated by an experiment, a true experiment or any type of experiment. They're generated by real behavior of real people and many students to UNC. Therefore, all other things are not held constant. They're just to give you an example so that we can think about this.

If we think that a student -- if we know that a student is Hispanic in the applicant pool, we cannot say all other things are constant. An Hispanic student might be likely to have parents' education being somewhat different, perhaps lower, than non-Hispanic students. An Hispanic student might be more likely to come from a high school that was less highly resourced. An Hispanic student might have had less access to AP classes and programs in his or her high school. We cannot

put all of those things in constant.

When we sort of flip a student from being white or Asian to being an underrepresented minority, other things move too, right? That's correlation, and that correlation means that it is not like the drug example where we held everything else constant and we just turned the placebo into the real drug back and forth, everything else staying the same.

In the UNC admissions example, once we start to put a student's race, we also move all of the other things because that's just the way the data are. And so, therefore, this average marginal effect cannot be interpreted in the same straightforward way as I proposed in the drug example that I gave you.

Q. And that criticism of improperly flipping a switch, so to speak, on race, while holding all other factors constant, apply to Professor Arcidiacono's transformation examples?

A. Yes, all of his transformation examples are essentially trying to do the same thing. They're trying to flip a student's race, say, from white, African American, or the other way around; and in each case he's calculating an average marginal effect and suggesting that it somehow is going, thus the marginal effect of switching race, but, in fact, that's not just a sensible statistical thing to do under these circumstances.

Q. On this slide, you also refer to Professor Arcidiacono's,

quote, shares. Professor Arcidiacono testified that the share of out-of-state African American applicants admitted due to racial preferences was 91.1 percent. And we see that on -- is this the table you prepared in the bottom right corner reflecting that?

A. Yes. This table shows that, yes.

Q. So what does this analysis that you did relating to Professor Arcidiacono's calculation of shares show? Let's focus on that 91.1 percent.

A. So just to be clear so that we can all focus on the same number, that 91.1 percent is in the very bottom row of the table, showing what Professor Arcidiacono calls the share due to race and ethnic preferences, and that's the 91.1 percent in the African American applicant column, okay?

All right. So it -- I think the way it -- it would be easy to interpret this as 91.1 percent of the admissions decision was due to race and ethnicity in the case of African American applicants; but, in fact, because this is not a proper statistical way to calculate the share of the admit/reject decision that's according to race and ethnicity, those shares add up to far more than a hundred percent.

For instance, we can see that the share due to SAT preferences that's in the top row is 100 percent, and then the share due to GPA preferences is 21.1 percent. The share due to the essay writing preferences is 100 percent. The share due to

the personal quality rating preferences is 100 percent. It all adds up to 543.4 percent, the decision.

Well, there's a pretty obvious way in which this cannot be the right way to divide up the admissions decision into shares or buckets, or whatever you wish to call them, because you can't possibly divide something up into more than 100 percent of the total.

So this -- this method that he has of calculating shares is not statistically valid. It's essentially why we do the Shapley decomposition. That is the right way to understand the marginal effect of any type of factor or group of factors. This type of analysis is simply incorrect.

Q. And we just spoke about the share in quotations for African American applicants and admits.

Does the same conclusion apply with respect to Hispanic students?

A. Yes. So the -- the so-called share due to race and ethnicity preferences for Hispanic applicants is 70.2 percent.

Q. And what's the total, according to Professor Arcidiacono's measure of shares for Hispanic applicants?

A. It is 557.4 percent.

Q. Let's turn now to Slide 17.

Professor Arcidiacono emphasized not just the marginal effect of racial preferences, but the average marginal effect.

What's your response to that point?

A. Well, we move on to look not at the average marginal effect, but, instead, at the median marginal effect. Even if we accept this shares analysis, which I do not, we would still want to look at how the median student is affected. That would mean half of the students were above, half of the students were below. With the average marginal effect, it grossly exaggerates the role of outliers. And let me give an example because I think that will help with our understanding.

Let's say I have a student who Professor Arcidiacono's model predicts has a 10 percent probability of being admitted to UNC, and I do his shares analysis and flip the student from being one race to another race, and his model says that this student's probability of admission goes from 10 percent to 90 percent. Okay. That's an 80 percent increase, according to his modeling. That means I could have 80 other students, according to his model, lose just 1 percent in their probability of admission to UNC.

For instance, I could have students who go from 68 percent to 67 percent. I could have 80 students like that, and they are completely offset by this one student in his model who goes from 10 percent to 90 percent.

So we can see that this student with a very big change in the models predicted admissions probability outweighs 80 students, potentially. And, in fact, that does happen in his model, because if we look at the median marginal effect, as he

defines it, then what we see is that it is very, very small compared to the average marginal effect, showing that the average is dominated by outliers.

Q. And is that reflected on the two charts on the right of Slide 17?

A. Yes. So let's look at the in-state chart which is on the top on the right-hand side of this slide. So Professor Arcidiacono's so-called marginal effect of race is 12.7 percent. This is from his Table 3.3 for in-state students who are African American; but if we look at the median marginal effect of race for African American in-state students, it's only 1.2 percent, demonstrating that the average must be highly influenced by outliers.

We can see that the same thing is true if we look at out-of-state African American students -- those are shown on the chart that's just below -- or if we look at Hispanic students where, for instance, on the in-state students, the so-called marginal effect of race drops from 9.7 percent, if we consider the average, to 2 percent, if we consider the median, again showing that outliers are dominating these statics that he is calling shares.

Q. Thank you.

On Slide 18, do you have one final criticism of Professor Arcidiacono's calculation of average marginal effect?

A. Yes. It is that those of us who do modeling, we always

need to have a kind of humility because our models only explain part of the way the world works, and we need to pay attention to the fact that many of the things that happen in the world cannot be explained by our models. That's particularly true here in the admissions decision where so much of the admissions decision appears to be nonformulaic or holistic, and, therefore, our models are only picking a part of the admissions decision to begin with.

When Professor Arcidiacono chose marginal effect, he's only reflecting changes in the probabilities predicted by his model, sort of pushing aside the fact that the model only explains a share of the admissions rejection decision, so when a -- you may recall when we were discussing the last slide, I said the student could be predicted by the model to have a 10 percent probability of admission or predicted by his model to have a 90 percent probability of admission. That was -- I kept saying "within the model," essentially. In fact, that student may have had a completely different admissions probability than 10 percent or 90 percent because the model is only explaining a share of things.

So if you -- if you always say things within the model, you keep ignoring the fact that the model doesn't explain everything. You are, in fact, doing a sort of injustice to the data because you're not trying to fully explain what's really happening in the world.

Q. Thank you.

Let's turn now to a concept you raised before of accuracy of a model. And let's turn to Slide 19, please.

Professor Arcidiacono focused on your discussion and calculation of mean squared error in assessing the fit of a model.

Did you also do an entirely separate test for overfit?

A. Yes, I did the correct test for a nonlinear model, which is due to Bilger and Manning, and I believe you'll be able to find that in my report.

As I said before, admit/reject is not a linear model. It is a choice model where we're going admissions/rejection. There are two choices. That's our binary model. Then for nonlinear models, the best measure of overfitting is due to Bilger and Manning cited in my report.

I did those tests, yes.

Q. Did Professor Arcidiacono respond to that analysis?

A. Well, he did not do Bilger and Manning tests, so far as I know.

Q. Okay. Thank you.

Which -- so looking at Slide 19 -- you might have said this before, but how do you calculate the accuracy of a model, in your opinion?

A. The accuracy of a model is how well it performs out of sample compared to how well it performs in sample. That's --

when you say a model is accurate is that we estimate it on one set of data and we then try it out on another set of data to see whether it still predicts accurately. If it does not predict as well out of sample as in sample, we say that a model is overfit and cannot be used to predict accurately. So that's -- it's a relative measure.

Even if your model does -- has a very high R-squared in sample, if it then predicts worse out of sample, it isn't an accurate model. And I mentioned before that I can always maximize the R-squared of a model in sample. It's very easy to get it to be a very high number. So then the test would be whether that apparently very high R-squared model, when I take it out of sample, does it still do well -- just as well. That's what we're looking for. In fact, people often split their data into two halves, and they estimate the model on one half of the data, and then they test, or validate, the model on the other half of the data to ensure that their model is not overfit.

Q. Would it also work if you tested one year of data in sample and multiple years out of sample?

A. Yes, that would also work. So, for instance, I could estimate the model on the 2014 admission cycle at UNC and then use another admission cycle like 2015-'16 or 2016-'17 as my out-of-sample data and test the model to see whether it performs equally well on those other years of admissions

decisions.
Q. Now, if I understand what you just testified, you said this is a comparative measure. In other words, does that mean we can look across the row for, say, Model 4?
A. Yes. What you want to do is look across the rows because what matters is the difference between in sample and out of sample. That's what matters.
So, for instance, if we look at Professor Arcidiacono's Model 4 for in-state students that's shown in the little table that's on the top left, we can see that his Model 4, which I believe is his preferred model, has an in-sample mean squared error of .055 and an out-of-sample mean squared error of .074, and that's a pretty big difference. It's going up by almost -- .074 is quite a lot larger than .055. That difference, in level terms, is .019.
Q. Professor Arcidiacono testified that you could look at the out-of-sample error for one of his models, say Model 7, and compare it to the in-sample error for your Model 9.
Do you agree with that?
A. No, that makes no sense, and the reason it makes no sense is that all measures of whether a model is overfit have to do with this relative comparison for the same model in sample versus out of sample. Okay. So if we look at his Model 7 instance, the in-sample mean squared error is .028. The out-of-sample mean squared error is .093. That's a massive

difference in mean squared error in sample versus out of sample. So we know that that model is grossly overfit. Okay.

The fact that --

Q. Please continue.

A. The fact that the out-of-sample mean squared error in that grossly overfit model is .093 is essentially irrelevant to any sort of comparison with another model because what we know now about his Model 7 is that it is grossly overfit. So it does have a -- a slightly lower out-of-sample mean squared error than my preferred Model 9, but that's just another way of saying he was maximizing R-squared even at the expense of showing a very, very inaccurate model. You can always get a lower mean squared error by maximizing R-squared, but that does not -- that is not a measure of the accuracy of the model. That Model 7 is grossly overfit and very inaccurate.

Q. Let's turn to Slide 20.

Professor Arcidiacono testified that you were wrong in presenting mean squared error across models in terms of a percentage.

What's your response to that criticism?

A. Well, I think you can present the in sample versus out of sample in many different ways. If we look at this table, the key thing always to see is what is the in sample versus what is the out of sample, and are they different. And if they are about the same in terms of mean squared error, then your model

is not overfit, whereas if it goes up between in sample versus out of sample, then your model is overfit.

Now, how you want to look at those differences between the in-sample number and the out-of-sample number, you can do it however you like. They're just two numbers. Okay. So I could look at Model 4 and say it goes from .055 to .074, and that difference is .019. Okay. That's one way to look at it. Or I could take that .019 and divide it by the in-sample mean squared error. That would be as a way to sort of standardize it so I could compare across models, but it's still the same difference in mean squared error.

It doesn't matter how you present it, and no one is trying to hide anything here. We have in-sample mean squared error. We have out-of-sample mean squared error. You need to look at those two numbers. That's what tells you whether a model is overfit.

Q. Professor Hoxby, does this discussion of overfit change your conclusion that race is not a dominant factor in the UNC admissions process?

A. No, because my own preferred model, Model 9, which is not overfit, as you can see from the statistics -- it does about as well out of sample as it does in sample -- shows, according to the Shapley decomposition, that race and ethnicity do not play a major role in admissions.

And I might mention that we earlier looked at Professor

Arcidiacono's preferred model, which is his Model 4. His model is somewhat overfit. It's certainly overfit, but it is not grossly overfit. And we also saw that when we used his preferred Model 4, the Shapley decomposition demonstrated that race and ethnicity play a small role in admissions.

Q. Thank you.

MS. FLATH: Your Honor, this might be a good time for our morning break.

THE COURT: Yes, I agree. All right. Let us take a break. We will return at 20 after 11:00.

MS. FLATH: Thank you.

(A morning recess was taken from 11:08 a.m. until 11:20 a.m.; all parties present.)

THE COURT: You may proceed.

MS. FLATH: Thank you, Your Honor.

Q. (By Ms. Flath) Professor Hoxby, can you please turn to Slide 21 of your demonstratives?

A. Yes.

Q. Professor Arcidiacono testified that his model, including his preferred model, was extremely accurate, over 90 percent. Do you recall that?

A. Yes.

Q. Setting aside any disagreement you might have with his definition of accuracy, what happens if you remove racial preferences from his preferred model and recalculate the

accuracy using his approach?
A. So I do not agree with his definition of accuracy, which I think is novel and nonstandard; but even if we accept it, then we can just take his model -- his preferred model, which is Model 4, and assess its accuracy with the racial preferences and then removing racial preferences. So literally, when we remove the racial preferences, I am zeroing out all of the coefficient on race and ethnic variables, so I am just removing the impact of those variables from the model.

All right. So let's say we do that with the in-state students. His so-called accuracy is 92.1 percent with the racial preferences, with these race and ethnicity variables, and it falls to 91.1 percent without those race and ethnicity variables. So that is the reduction in his so-called accuracy of 1 percent. And if we look at the out-of-state students, it's not all that different. The reduction in his so-called accuracy is 1.9 percent.

So even if we accept this oddly defined accuracy notion, it doesn't really change what we are learning about from his model -- preferred model, which is that it is not race and ethnicity variables that are generating the so-called accuracy; it is other variables that are generating the so-called accuracy. Race and ethnicity are contributing almost nothing.
Q. And by "almost nothing," you mean contributing almost nothing to the accuracy of his model?

A. Yes. Race and ethnicity are contributing almost nothing to the so-called accuracy of his model, accepting his definition of accuracy.

Q. Thank you.

Did you analyze the allegation in the complaint that the school group review process is used to manipulate the racial composition of the admitted class?

A. Yes, I did do that analysis.

Q. And did you prepare a slide showing the results of that analysis?

A. Yes, I did. I believe that is Slide 23.

Q. Great. Starting with the first row, what does Slide 23 show us with respect to the school group review process?

A. Let me explain what is being shown on Slide 23 first so that everyone is on the same page.

What I did in order to analyze the school group review process is I looked at the class of students who would have been admitted before school group review, and then I looked at the class of students who were actually admitted after the school group review process. I looked at the racial composition of the before SGR and the after SGR class of students.

So, for instance, let's take the first row. This is for African Americans, and I'm breaking it up separately by the admissions year. In the 2013-2014 admissions year,

10.1 percent of the students were African American before school group review, and 10.1 percent of the class was African American after school group review. There was no change.

In the 2014-'15 school year, the percentage of students who were African American was 9.3 before school group review and fell by 0.3 percent after the school group review process.

Similarly, in 2015-'16, it was 10.1 percent African American before school group review, and it fell very slightly by 0.1 percent. That's the first row of this.

Q. And what did your analysis show in general with respect to Asian applicants?

A. Looking at the second row, we can see that in 2013-'14 the number of Asian students rose after school group review from before to after. It also rose in 2014-'15, and again in 2015-'16 it rose after school group review. So it appeared that school group review was moving -- if anything, it was moving race and ethnicity towards being just a little bit more Asian.

Q. And what did you conclude with respect to Hispanic applicants?

A. With respect to Hispanic applicants who are shown in Row 3, you can see that in 2013-'14, it dropped after school group review; there was no change at all in 2014-'15; and there was a very small change in 2015-'16, but it was a negative change. The percent that were Hispanic dropped just a little bit.

Q. And what about with respect to white applicants?
A. White applicants are shown in the bottom row of this table, and you can see that in 2013-'14 it was a small positive change after school group review, so the class was very slightly more white; in 2014-'15, something similar happened, the class became slightly more white after school group review; and in 2015-'16, there was no change.

I should mention, though, that if we look over this table as a whole to understand it as a whole, these are all very small changes. We're not seeing big changes in the percentage of the class belonging to any racial or ethnic group in the school group review process, suggesting that race and ethnicity is actually not playing any sort of important role in the school group review process, because, otherwise, we would expect these numbers to jump more substantially somewhere.
Q. Thank you. Now, as a result of all of these analyses you testified about this morning, did you find empirical evidence that race is the dominant factor in the UNC admissions process?
A. No. I concluded that race and ethnicity could not be a dominant factor in the admissions process, and I feel that every approach that I tried to understand or analyze that question brought me to the same conclusion that race and ethnicity were playing a small role in the UNC admissions process.
Q. Thank you.

Let's turn to your second opinion regarding race-neutral alternatives, and let's turn to Slide 25.

At a high level, what is your process for testing a race-neutral alternative?

A. Okay. So testing a race-neutral alternative is a process that has several different steps to it. The first step is deciding what the alternative is. So in many cases we were following suggestions from the Plaintiffs or suggestions that might have only been tangentially referred to by the Plaintiffs, but still trying to test any alternative that the Plaintiffs had considered. So we have a -- that's the first step is to think about what is the alternative admissions process.

Once we've decided --

Q. When you say "referred to by the Plaintiff," do you mean in the complaint?

A. Yes, in the complaint the Plaintiffs referred to some race-neutral alternatives they thought would be useful, and so we took up each and every one of those possibilities. And we tried to also use the race-neutral alternative that was as close as possible, given the papers, journal articles, and books that they had referenced in the complaint. I believe we also took up a number of race-neutral alternatives that were not suggested by the complaint but that were suggested later in Mr. Kahlenberg's reports.

Q. Thank you. So after you have decided the race-neutral alternative, what do you do next?

A. The next step is that we have to decide who would apply a race-neutral (indiscernible).

(Court reporter requests clarification.)

Q. Was the last word you said "alternative"?

A. Under this race-neutral alternative, yes.

I think the most obvious example here idea is that if we were to move from UNC's current admissions process to a top 10 percent plan, like that of Texas, we would expect a different set of students to apply, potentially, in the case of Texas, in the top 10 percent of their high school class based on class rank. So we do have to make a decision about who would apply, and that requires a model. So that's step number one.

Step number two is to determine who would be admitted under the race-neutral alternative. And for that, I would be using the same sort of admissions models we've been discussing already today. They are not perfect admissions models because, of course, we did not know everything about a student that an admissions officer can see, but they do -- they do the best that we can do in trying to understand and mimic the UNC admissions process as well as we can. Not perfect, but that's what we're trying to do.

And then the final part of any race-neutral alternative

simulation is that we have to decide -- or we have to figure out who would enroll. It's also extremely important and it's been overlooked, because I do not think UNC really cares very much about who else was in the pool (indiscernible).

(Court reporter requests clarification.)

Q. Professor Hoxby, let me help where you were.

Why is it important to consider who would enroll as part of a simulation?

A. Right. It's very important to consider which students would actually enroll because what students experience at UNC is their fellow students in class, in their dorms, in social life. They do not experience the students who were admitted to UNC and who decided not to enroll. So we also have to do this last step where we look at the group of students who are admitted and we figure out what percentage of them would enroll at UNC, a very important step.

Q. Regardless of whether we talk about the matriculation phase today, did you run a matriculation model for every race-neutral alternative that you simulated?

A. Yes, I did. And I believe that it's very important to both compare what the admitted class looks like under the race-neutral alternative to the actual class that's admitted and to compare the predicted matriculated class or enrolled class to the actual enrolled or matriculated class. In every case under every race-neutral alternative simulation, I looked

at both the admitted class and the matriculated class.
Q. After you've gone through this process, how do you compare the results of a simulation against levels of academic preparedness and underrepresented minority diversity?
A. Well, I was asked -- we sort of go back up to the top. I was asked to conduct race-neutral simulations and conclude from those race -- or draw conclusions of evidence from those simulations about whether there was an alternative that would allow UNC to attain its actuals in terms of racial and ethnic diversity and academic preparedness. So following that guidance, I compared the results under each alternative to what UNC actually achieves right now, and I tend to call those the actuals.
Q. The actuals; is that right?
A. Yes, I call them the actuals.
Q. In terms of measuring academic preparedness, do you use average SAT score?
A. I use average composite SAT scores. And I should add that ACT scores are translated into SAT scores using the same concordance tables that UNC and all other colleges and universities use. So when I say SAT scores, I do not mean merely the students who take the SAT, but the students who take either the ACT or the SAT where they're all being put into the same basis. But, yes, I do use SAT scores as an indicator of academic preparedness.

Q. And why even for in-state applicants do you consider average SAT as compared to average SAT and GPA?
A. Okay. So the difficulty with using GPA in addition to SAT is that different high schools have quite different grading standards. This is really obvious in the data. And, therefore, if we use GPA in addition, what we tend to do is just create a misleading error because we cannot compare a 3.0 from one high school to a 3.0 in another high school and assume it's the same thing.

I wish to say very clearly that I do not consider the SAT or the ACT to be perfect measures of academic preparedness, not at all. These tests are imperfect. They have issues. There are issues around bias in these tests. There are issues regarding test retaking. So they are not perfect academic indicators, but they are standardized across high schools, and so they are the way that most economists and statisticians do try to judge academic preparedness. As imperfect as they are, they are better than the alternative -- they are better than other types of indicators.

Q. So to be clear, do you offer any judgment or opinion on whether UNC should consider implementing an alternative admissions process that results in a decline in racial diversity?
A. I was asked to offer an opinion on whether UNC could use a race-neutral alternative to attaining current levels of

academic preparedness and race and ethnicity, and I really don't have any opinion on what decline UNC -- that's not what I was asked.

Q. And the same holds true for any decline in average SAT score, even if it's a decline of, say, 10 SAT points on average?

A. I was asked whether UNC could use a race-neutral alternative to attain its current levels of academic preparedness, and that's what I am prepared to give evidence on.

Q. Against that backdrop, how do you consider the concept of workable in assessing race-neutral alternatives?

A. I tried any race-neutral alternative that seemed workable to me in the following sense: One, you can rely on data that UNC could actually gather. That was the first criterion. And then the second criterion was that it should be an alternative that I believed a real admissions office would implement, even assuming that it might be hard for the admissions office to implement it in the first few years. I was willing to consider that, but I didn't want to consider alternatives that appeared to me to simply be unimplementable.

Q. Let's talk a little more specifically about how you approached these hypothetical simulations.

Turning to Slide 26, in creating a simulation, what assumptions did you apply?

A. Well, what I was trying to do at a high level was consider if every race-neutral alternative that I considered was the best possible chance of attaining the actuals, of attaining what UNC is actually achieving now. And so, inevitably, when one is going through this type of procedure, one has to make some assumptions, and I always tried to make them, you know, matter, that would favor the alternatives or make the race-neutral alternative look as good as possible. In that way I think you could say that I chose assumptions to kind of give each race-neutral alternative a ceiling, its highest possible level that is realistic of being able to achieve the actual. But I made several assumptions to try to do that.

Q. What was the first assumption you made with respect to the applicant pool?

A. So the first assumption that I made is a very important one. I assumed that even under the race-neutral alternative all of the people (indiscernible).

(Court reporter requests clarification.)

Q. You assumed even under the "race-neutral alternative"? Was that the right word?

A. Yes, that was the right word. Thank you.

Q. Please continue.

A. Even under -- I'm sorry. Please do interrupt me if you can't hear me, because I really -- I'm really sorry if you cannot. I know how frustrating that must be.

Even under the race-neutral alternative, I assume that all of the students who currently apply to UNC would continue to apply. Now, this is an important assumption, and it is very much favoring the race-neutral alternatives. And let me explain why.

When Texas and California moved to having race-neutral admissions processes, in fact, many students who had previously applied to the University of Texas or Texas A&M or Berkeley stopped applying, and they stopped applying because they were less favored under the race-neutral alternative than they had been favored under the previous admissions system. And so it is not the case that all students will continue to apply.

For instance, I can imagine that there might be a very high-achieving African American student who might be applying to UNC now and would say, Gosh, UNC has moved to a race-neutral admissions system; my contribution to racial and ethnic diversity will not be considered; and, furthermore, the racial and ethnic diversity of the UNC class might decline, and so, therefore, I will apply to Duke instead; I'm not going to apply to UNC anymore.

What I have assumed is that all of the students who apply now would continue to apply under a race-neutral alternative. I think you can see that that is optimistic for the race-neutral alternatives. This is really a big assumption that I make here to favor the race-neutral alternatives.

Q. What else did you assume with respect to the applicant pool that would apply under a race-neutral alternative?
A. Under any race-neutral alternative, we know that some students who would not have been -- who would not have had a high probability of admission before will have a significantly higher probability of admission. I'm going to call those the newly eligible student because they are the students who are made more eligible for admission by the race-neutral alternative than under the current admissions system.

What I assume is that 75 percent of the highly qualified, newly eligible students, in fact, apply to UNC. This is also an optimistic assumption because it's assuming that there is a very high rate of newly eligible students immediately saying to themselves, Gosh, I think I can get into UNC maybe now by putting that in under the old admission system; I'm going to surge forward and apply and do all of those things, even though there may be not very much data to support someone like me having been successful in UNC admissions in the past. It's an optimistic assumption.

Q. Now, you used in all of your simulations the NCERDC data. How did that data influence your assumption on test scores?
A. In north -- the NCERDC data are taken straight from the administrative records of North Carolina public schools. They're administrative data. One of the things that happens in North Carolina is that in March of their junior year, all

students, with very few exceptions, are required to take the ACT. That's what I'm going to call the mandatory ACT test. In addition, nearly all students who are in the NCERDC data have ACT scores from that March of their junior year of testing. I should add that many of them do not prepare for that mandatory test taking. It's just something that comes along in their junior year, and they kind of have to do it.

Q. Professor Hoxby, if you might just slow down a tiny bit. I think that will help the court reporter and our video connection. I'm sorry to interrupt. Please continue.

A. No, please do remind me. I tend to speak quickly by nature, and so I'm -- I need to be reminded and I don't mind at all.

So that's the mandatory March-of-the-junior-year test taking for which most students do not prepare, especially students who do not believe that their ACT score is going to make an important difference in admission to college.

If a North Carolina student believes that he or she is going to be applying to UNC, then typically that student would either retake the ACT, so two testings of the ACT, or might take the SAT after having that mandatory ACT testing. There are even some students who take the SAT or ACT more times than two, who take them multiple times.

What I'm assuming, again to try to favor the race-neutral alternative, if that -- is that a newly eligible student would

take the test at least twice, so either retaking the SAT -- sorry -- retaking the ACT or taking the SAT after having taken the ACT.

Now, why does that matter? This sounds a little bit technical, but it does matter because if we think about a student who would not have considered applying to UNC before and then we put that student's data into the simulations, that student would probably have had a higher ACT or SAT score if he or she was actually applying to UNC. So what I do is I add 40 SAT points to the score of any student who only took the ACT once in the mandatory testing, and that helps boost the race-neutral alternatives relative to the actuals. It helps make the race-neutral alternatives look better.

I should say that that 40 points is not just something that is ad hoc; rather, it comes from very serious research conducted by ACT about the effect of retaking the exam.

Q. You spoke a little earlier about why it's important to consider who would enroll under a new -- under any admissions process.

What did you assume with respect to current enrollment probability?

A. What I did for this part of the procedure was that I assumed that current enrollment probabilities would continue to hold. This is not a particularly complicated part of the procedure. I have a very simple model of what is the

probability that a student will enroll conditional on that student having been admitted. Even though I said this is simple, it is not something that we can just ignore. And let me give you an example.

UNC is a very selective university, but it is not the most selective university in the United States; and, therefore, students who have extremely high test scores, grades, and other qualifications such that they might be admitted to one of the top private universities in the United States -- let's just say Princeton, as an example -- have a somewhat lower probability of matriculating at UNC if admitted than a student who might have qualifications that are more squarely in the middle of the student body at UNC. And, therefore, I cannot just assume that every student has an equal probability matriculating. Students who are more likely to have good alternative opportunities are a little less likely to actually matriculate at UNC.

Q. So let's turn now to the very simulations that you ran.

On Slide 27, you describe your -- you describe your approach as exhaustive. In what way do you consider your approach to have been exhaustive?

A. Well, first, I did try to consider every race-neutral alternative plan that was proposed or suggested, even hinted at in any way by the Plaintiffs in the complaint or in any other expert report. So that's the first way in which I considered it to be exhaustive.

And you will see that I considered 82 different socioeconomic plans, five top X percent plans, two geography-based plans, and then a bunch of additional concepts that were suggested by Mr. Kahlenberg. So that's the first way in which it was exhaustive.

The second way in which it is exhaustive is that I tried very hard under each one of those plans to allow for a wide range of possibilities about how a plan would actually be implemented. I think we're going to talk about that later in some detail, but I was -- I was trying to allow for a wide range of possibilities.

And then the third way in which I tried to be exhaustive is I tried -- I've already emphasized that I chose assumptions that try to get me to something that was like a ceiling for each plan; but, in addition, on two important occasions, I created a way of doing the race-neutral alternative which was purely designed to maximize the power or the ability of the race-neutral alternative to attain the actual.

These two -- these two demonstrations were -- they're not -- in some sense they're not truly race-neutral because I was simply going out there to say, Can I come up with a race-neutral alternative that will attain the actuals using all of the data that I had at my disposal? And so it was our -- they are -- they were really just designed to try to make a race-neutral alternative work as much as possible, regardless

of any of the other suggestions.
Q. And based on this exhaustive approach, how many simulations resulted in attaining UNC's actuals measured in terms of average SAT and underrepresented minority representation?
A. Zero.
Q. Let's turn to something that the Court has heard about: Socioeconomic status-based plans. And I will do my best to not trip over that phrase. If I call it SES at times, that's going to be why.
Mr. Kahlenberg testified about socioeconomic status-based plans at some length. But at a high level, how do you describe the logic behind this approach as a race-neutral alternative?
A. The idea of an SES-based plan is that there are going to be some socioeconomic indicators that will be correlated with this condensed race or ethnicity. And so if we say that the race-neutral alternative has to be blind to the race -- in other words, it cannot use race and ethnicity variables -- we might be able to use these other variables in combination to come up with a proxy for race and ethnicity that might help UNC create a class that was racially and ethnically diverse even though admissions officers would not know anything about a student's race and ethnicity. And these types of proxies depend on the idea that socioeconomic variables are correlated or highly correlated with a student's race and ethnicity.
Q. And you list certain socioeconomic status indicators on

Slide 28. Would all of these indicators be available to a need-blind admissions office?

A. Yes, with a certain amount of work, I think, involved. These are not currently in the hands of any admissions office so far as I know in the United States, but they could be available to the admissions office.

For instance, when I say the percentage of adults with educational attainment ranging from essentially none to a doctoral degree, that's something about the neighborhood in which a student lives. And so currently I do not believe UNC admissions officers have that kind of data at their fingertips, but they could have it if they had a data officer, or someone like that, who tried to bring in data to contribute to that process.

Similarly, the mean number of dependents or the percentage of families headed by a single parent. I also looked at whether people owned their own homes and their house value if they did own a home. These are not variables that UNC has right now, but they are potentially variables that they could have if they made enough effort.

Q. Did you empirically test the correlation between socioeconomic status indicators and race using data in this case?

A. Yes, I did. I did it both in the Carolina Connect data -- so that's the data from the applicants at UNC -- and I also did

it in a much larger data set called the American Community Survey where -- that is a -- it's related to the Census. It's a 1 percent sample of the U.S. population. And, furthermore, I did this analysis in the NCERDC data set. That's the data set of all North Carolina public school students. So I tried to do it in all three of those data sets.

Q. And does Slide 29 reflect your analysis?

A. It does. And this is -- I think is very interesting because what I do is I start off with all students in North Carolina, and what I'm trying to understand is how good a job can I do with these SES variables in predicting a student's race.

So North Carolina students -- all North Carolina students on the top row. As you can see, if I look at all North Carolina students, I make errors in predicting race 83 percent of the time. And I think it's worthwhile saying, Why am I making mistakes? It's not that socioeconomic variables don't matter. It's not that socioeconomics doesn't matter. It's just that in North Carolina socioeconomics is not that correlated with race and ethnicity. Okay.

I think sometimes in the popular imagination people think all African American students are poor and all white students are nonpoor. That just isn't true in reality, and it's especially not true in North Carolina. Or someone might say all African American students go to schools that have a high

rate of free and reduced lunch, and all white students go to schools that have a low rate of free and reduced lunch. That's just not true.

So when we actually make use of the true data, what we find is that we make mistakes all the time because the socioeconomic variables are not particularly good indicators of a student's race and ethnicity. That's what we're looking at here at the top, which is this 83 percent error rate.

Q. And on the rest of the slide, you include varying SAT thresholds, moving from an SAT over 1000 to an SAT over 1260. Why do you do that?

A. It's because what really matters for UNC is not whether I can predict a student's race and ethnicity for any student. UNC applicants are high-achieving students. So I need to get into the range of students who are actually fairly likely to be admitted to and to enroll at UNC.

So if we look at that bottom line, SAT scores above 1260, that's really the heart of the UNC class. That's really -- those are students who are in the heart of the UNC class. They make up a lot of the student body at UNC.

Well, now I'm trying to predict their race and ethnicity using these socioeconomic variables, and you can see that the error rate is 94 percent. And the reason that this makes complete sense, the reason why it's higher is that a student who is an underrepresented minority, who is a high-scoring

student in North Carolina -- so let's take an Hispanic student with an SAT score of 1260 -- that student is less likely to be in poverty, to go to a high school with a very high rate of free and reduced lunch, to live in an area where very few of the adults have, say, a college degree. That student is just a little less likely to live in one of those areas. So as I go towards higher and higher-achieving students, the socioeconomic variables do less and less well at substituting while actually being able to observe a student's race and ethnicity.

Q. And just to be clear, when you talk about this proxy and a socioeconomic status indicator, are you talking about a single variable or all of them?

A. No, I'm talking about using all of them in combination to predict race and ethnicity as well as I possibly can.

Q. Thank you.

Let's turn now to some of the specific socioeconomic status-based simulations that you tested.

On Slide 30, do you list how you go about doing that?

A. Yes. The first step which is listed under Point 1 is that I construct an SES index measure for every applicant. And this SES index measure is going to be based on all of those socioeconomic variables that we've just been discussing, some of which we didn't get a chance to discuss, but there are a lot of them. Okay. So I have to create an SES index for each applicant.

Then the next step is because I want to test the full range of every race-neutral alternative -- so I don't want to just create one version of it and test that and then leave all the other versions on the cutting room floor; instead, I define a range of emphasis -- that's the weight that the SES index gets in admissions -- and I also define a threshold for what will be considered to be a low SES student. So I can give you a simple example.

A simple example would be that I say about 750 places in the admissions -- in the admitted class are going to be set aside for low SES students. That would be the emphasis, but I could increase the emphasis and make it 1,000 students or I could decrease the emphasis and say we get 500 students. That would be the range of emphasis.

And then there's also a threshold. So I have to decide what is a low SES student. That's not actually an obvious one to answer. It's not obvious. So I want to consider a range. Do you have to be in the bottom 20 percent based on SES? Could you be in the bottom 25 percent? Do you need to be in the bottom 15 percent? That's the threshold. So I'm moving the threshold around. I'm moving the emphasis around. That way I get to test the full range of what this race-neutral alternative could do. I'm not testing this one little case.

Q. For each SES simulation you ran, how many versions did you test using these different ranges of emphasis and threshold?

A. 20.
Q. So for each of the 82 different socioeconomic status-based simulations, you ran 20 versions?
I'm sorry. I think I messed up the math.
For each simulation you ran 20 versions?
A. That's right; for each immolation I ran 20 versions, yes.
Q. This is why lawyers should not do math.
What did you do next in creating your socioeconomic status-based simulation?
A. Okay. So now we have -- we now have -- we sort of set out what we're going to do. We created the SES index. We've decided we're going to look at all of these different ranges of emphasis and thresholds, and we really get to stress test this race-neutral alternative. And now we have to predict which students would be admitted, and that's what I call the SES -- or the SES -- it's not just SES, but that's the part of the process where I'm trying to use the SES index to admit the class, giving extra favorability to the low SES students in the -- in admission to the class. And I do that in a way that's very favorable to the race-neutral alternative because what I am assuming is that the students are admitted by UNC from that SES-disadvantaged class -- disadvantaged applicant pool in order of being the most qualified for UNC to the least qualified for UNC.
I know this part is a little confusing. Let me just say

perhaps I had decided that there should be 750 students set aside for low SES students, 750. So I start with the most qualified low SES student, and I just keep admitting students until I get to 750 students from the low SES pool.

Now, this really favors the race-neutral alternative because I'm basically assuming that all of these low SES students -- not all of them, but a lot of them are applying to UNC, and that when UNC is doing its admissions process, it's paying a lot of attention to things like test scores and grades. So it's going to make the race-neutral alternative to achieve the actuals which are average SAT scores. So this part of the process is very favorable to the race-neutral alternative's ability to achieve the outcomes.

Q. And what's your final step?

A. The final step is what I call "completing the class." So we just described how we admit the students who are in the 750 who are low SES, but we still need to admit the rest of the UNC class. And this is a kind of tricky thing to do.

So it's tricky because what we want to do is be absolutely as realistic as possible, but we clearly cannot assume that every student who would have been admitted now under the current process would be admitted in the future to UNC because there would be simply fewer seats for them.

So what we do to complete the class is that we take a random draw from the -- from the current students who get

admitted to UNC. So we know that UNC, under the current process, thought they were a good applicant, would randomly draw students and use those students to complete the class, because we don't want to -- we want to be as close as possible to what UNC is actually doing, but we don't know which students would end up being admitted or not admitted under a future scenario. We don't just complete the class by drawing randomly once. We randomly draw a hundred times in a row in order to try to figure out what that -- what the rest of the class would probably look like in a realistic kind of way.

Q. Now, Mr. Kahlenberg testified that that "completing the class" phase, as you just described it, was not race-neutral.

Is that true?

A. In some sense it is not, but it is also by not -- I -- it is designed to be favorable towards the race-neutral alternative. Let me explain why.

So you'll remember that I gave you the example of the student before who was African American and very high achieving who might decide not to apply to UNC after the race-neutral alternative was put in place. A student might decide to apply to Duke or Princeton or whatever other college. So that student is still going to be there in the pool of admits when I am starting to randomly pull out students and assume that they are admitted to UNC.

In actuality, a high-achieving African American student

would probably be less likely to be in the pool of applicants because the student would have decided, I prefer to go to another school; maybe it's more race conscious or has a more racially diverse class.

So by allowing that student to still remain in the pool of students from which I'm choosing randomly a hundred times, I have favored the race-neutral alternative because I have kept the racially diverse underrepresented minority applicants in the pool of applicants, even when they might have actually dropped out under the race-neutral alternative. This will help the race-neutral alternative look good because it will mean that I can achieve both higher racial and ethnic diversity and higher test scores of completing the class in the way I do.

So I'm not disagreeing with Mr. Kahlenberg, but I think he doesn't -- he wasn't being very clear about the logic of whether this favored the race-neutral alternative or somehow didn't. I'm not sure what his logic was.

Q. Turning to Slide 31, I think you covered many of these assumptions, but did you make additional assumptions specific to the SES plans?

A. Yes. So the first favorable assumption for the SES plans was that I assumed that if we could identify -- first of all, I assumed that UNC could identify all socioeconomic disadvantaged students. I actually consider this to be a pretty optimistic assumption because, in fact, there is no admissions office in

the United States, to the best of my knowledge, who is doing something as sophisticated as UNC would be required to do to identify all socioeconomically disadvantaged students.

This would be a huge data effort and a huge analytic effort at UNC. It is possible for sure, but it is not something that anyone is doing now. So that is the assumption I made, and as I say, it's optimistic.

The second assumption that I made is that UNC would be able to get the socioeconomically disadvantaged students who apply at the same rate as current well-qualified applicants. Again, this is pretty optimistic because this is saying essentially we get a poor student from a high school where almost no one has ever applied to UNC in the past, very rare to see applications from that high school, and we assume that that student has the same probability of applying to UNC as a student from, say, North Carolina, you know, Academy of Math and Sciences. That seems to me like a pretty optimistic assumption. Because for some students it's very natural to apply to UNC. It's something all their peers are doing. It's something their high school counselor is used to doing. And I'm assuming that somehow the student who is from that high school -- almost no one does this. It just kind of instantly turns into an applicant.

The second thing -- can I go on?

Q. Please.

A. Okay. The second thing I did was assumed that UNC chose to admit the highest scoring student. So I think we talked about this a little bit when discussing the previous slide, but this is also -- it's not an optimistic assumption. It's just an assumption that favors the race-neutral alternatives because it allows the race-neutral alternative to have its best shot of achieving the actuals, so essentially assuming a way -- some of the things that we know UNC would actually consider -- UNC does not just admit the highest scoring students. That's not the way the real process works, but I assumed that it was in order to favor the race-neutral alternative and to give it its best shot at trying to hit the actuals.

And then I also assumed that the current admitted applicants would continue to enroll exactly in the way that they are enrolling now. Again, this favors the race-neutral alternative. There may be people who are put off by the fact that the racial and ethnic diversity of the university would have changed or the admissions process would have changed. In fact, we have seen that in places like Texas and California. It is not the case that all students are just indifferent to the admissions process or to the makeup of their peers at college.

So, again, this really favors the race-neutral alternative.

Q. Great. Let's talk now, as we've already discussed the "completing the class" phase, about some of the categories of

SES-based simulations that you ran.

So turning to Slide 32, please explain the various SES indices you used.

A. Okay. So every SES index has to have a kind of logic to it because you're taking many, many variables -- SES-based variables, and you're trying to combine them so in some way that would be serving for a proxy for being -- it's a good indicator for being low SES, and it also needs to be a (indiscernible).

(Court reporter requests clarification.)

Q. Professor Hoxby, if you could just slow down a little bit more.

A. I'm sorry. Let me go back and say that every SES index is going to have to have some logic to it. That's because we have a lot of SES variables that we are including, and we can include them in a fairly complex, elaborate way; and so, therefore, there needs to be some kind of a logic for how we translate many SES variables into an index.

So two of the indices that were suggested by an article referenced in the complaint are the four-year college index and the two-year college index.

So here's the logic of the four-year college index. Basically, it says if this socioeconomic variable predicts that a student is less likely to apply to a four-year college or enroll in a four-year college, we are going to assume that that

socioeconomic variable is bad for college enrollment. So we'll give that socioeconomic variable more weight in the index.

And if it -- if a -- if a variable, instead of having parents who have a graduate education, predicts that students are more likely to apply to a four-year college, we will say having parents with a graduate education is going to suggest that you are not a low SES student. Okay.

So we're using the probability of a student going to a four-year college to help us understand which variables put a student at a disadvantage in the college admissions process, in the college preparation process, in sophistication about college going. We're really using that indication of four-year college to help us put the proper weights on the various socioeconomic variables.

Q. Is that --

A. The two-year college -- I'm sorry.

Q. I was going to say, does the two-year college index follow the same logic, just tailored to attending a college for two years rather than four?

A. Yes, it follows exactly the same logic. The only difference is that the outcome that is helping us make these decisions about the weights is whether a student attended a two-year college or not.

Q. At a high level, how do you construct what you call a striver index?

A. So a striver index was also suggested by -- or hinted at by one of the -- or possibly two in the complaint. A striver index is the difference between the actual test score that a student achieves and the predicted test score that a student achieves. The striver index is meant as an intuitive matter to -- to suggest that a student is outperforming the expectations that we would have for a student based on his or her socioeconomic background. So I think that's the -- that's the logic of the word "striver"; this person is striving beyond his or her socioeconomic background.

Q. And, finally, you talk a little bit about both your composite proxy as well as the very favorable index you created. Is that the race-predicting index?

A. Yes. So the race-predicting index is specially designed to try to allow socioeconomic variables to do the best possible job substituting for race and ethnic indicators. In some ways, it's not really a logical index. It's an index that I put out there simply to see what could I achieve with socioeconomic variables regardless of whether there's some nice logic like there is with the striver index or the four-year college index. It's just designed to maximize the possibility that socioeconomic variables can substitute.

So in some sense it's not really a race-neutral index because I need to use race in order to construct it. I'm literally just trying to predict race and ethnicity using

socioeconomics, which is obviously not truly race-neutral in some sense, but I'm really trying to push the socioeconomic variables to give me as much explanation as they possibly can.

MS. FLATH: All right. I know we're coming close to sort of the lunch break, Your Honor. I could certainly take Professor Hoxby through a simulation, or we can do that after lunch.

THE COURT: How long do you think that that --

MS. FLATH: I think we can do a few minutes on this one, and then we can break. Would that work?

THE COURT: All right. That works.

Q. (By Ms. Flath) So, Professor Hoxby, let's turn to Slide 33.

And this graphic relates to the simulations you ran based on the four-year college -- four-year likelihood-of-attending-college index, correct?

A. That's correct, yes.

Q. And what does each dot on the graphic represent?

A. So this is a fairly complicated graph, so I want to make sure that we all understand what's going on. There's a bit going on here.

So the horizontal axis, we're looking at the number of URM students who end up being admitted to UNC. And on the vertical axis, we're looking at the average test score of URM students -- underrepresented minority students. I hope it's

okay if I now say URM. It's just a little quicker.

All right. So at this point in the process, I'm just looking at the disadvantaged stage, so the stage in which I admit a certain number of socioeconomically disadvantaged students. This is before the completed class. I'm just trying to look at admitting students who are considered to be socioeconomically disadvantaged and then trying to see what do I -- can I get the actuals for underrepresented minorities in this first disadvantaged stage.

So the first thing to notice is that green dot. That shows you the actual class, the number of URM students, and the actual test scores of URM students in 2014-'15. That green dot is very important.

Then the rest of the figure is divided up into four quadrants. The upper right-hand quadrant is where we would like to see a race-neutral alternative end up because that is the zone in which in this disadvantaged stage -- in other words, admitting the socioeconomically disadvantaged students -- we attained both higher test scores and more racial and ethnic diversity. So if we had a race-neutral alternative that could do that, then a dot would end up in that sort of shaded quadrant.

In the quadrant that's just below that, so the bottom right-hand quadrant, if a plan ends up being there, then it means that we -- that the class would have more URM students,

but that they have lower test scores than the actuals.

If you end up in the upper left-hand quadrant, then that means that the race-neutral alternative has fewer URM students, but that they have higher test scores.

And the quadrant that you really do not want to end up in is that bottom left-hand quadrant where the race-neutral alternative achieves less racial and ethnic diversity than the actuals, and it also has lower test scores than the actuals.

So those are the four quadrants that you have.

Q. And does each dot represent one of the 20 simulations that you ran in performing this socioeconomic simulation?

A. It does. So each time I am testing the four-year college-related socioeconomic index, I try it with a different emphasis and a different threshold -- we talked about that a little bit before -- to stress test the entire range of what this type of plan could do. And you can see that most of the dots end up in that bottom left-hand quadrant where UNC has both fewer URM students admitted and they have lower test scores. So it's worse on both grounds than the actuals. And you can see in no case does the race-neutral alternative do as well as the actual class, which is the green dot.

Q. And for each of these 20 dots, after running 100 different lottery draws to complete the class, did you find any socioeconomic status-based race-neutral alternative using this index that would achieve UNC's actuals?

A. No. After completing the class in the way I described earlier, I was never able to find a race-neutral alternative using this index that achieved UNC's actuals, even with the favorable assumption I was making.

MS. FLATH: Your Honor, I think that's a good time to break for lunch.

THE COURT: All right. Thank you.

We are going to recess for lunch at this time. We will resume at 1:35.

(A noon recess was taken from 12:35 p.m. until 1:35 p.m.; all parties present.)

THE COURT: You may proceed.

MS. FLATH: Thank you, Your Honor.

THE COURT: Uh-huh.

Q. (By Ms. Flath) Professor Hoxby, let's turn to the simulations involving the race-predicting index which you discussed earlier. Let's turn to Slide 34 of DX506.

Now, other than the measure of socioeconomic status or the index, do you run these simulations precisely as we just discussed with respect to the first index that you measured?

A. Yes. The rest of the exercise is identical to the exercise that I performed with the four-year college-related socioeconomic index. The difference is that I'm using now a socioeconomic index which is designed specifically to maximize the power of socioeconomic variables to help me predict race

and ethnicity so that, therefore, this exercise is really trying to test the absolute ceiling of what could be achieved by a socioeconomic index in a race-neutral alternative. Otherwise, though, the exercise is the same.

Q. And what is your conclusion after running these simulations based upon that race-predicting index with respect to whether this alternative would replicate UNC's actuals?

A. So in no case out of the 20 cases that I used to stress test this race-predicting index was I able to see that UNC could attain its current racial and ethnic diversity and its current level of academic preparation, and this is for a fairly simple reason that we have discussed a little but during the morning, and, that is, that although socioeconomic variables are somewhat correlated with race and ethnicity in the state of North Carolina, they are not highly correlated with race and ethnicity in the state. And, therefore, it's simply not possible -- even when you use all of them together in the way that maximizes their power, it's simply not possible to proxy very well for race and ethnicity not being there in the application there.

Q. Thank you.

Let's turn now to some of the critiques you offer on Mr. Kahlenberg's approach to socioeconomic status-based simulations. Are those listed on Slide 35?

A. They are, yes.

Q. And can you give us an example of an unrealistic assumption that you believe Mr. Kahlenberg makes?
A. Well, I think that the most unrealistic assumption and the one that has very, very large effect is that Mr. Kahlenberg frequently fails to allow for the fact that the applicant pool would change if the admissions process changed. This has a very important effect on the outcomes of his simulations because it creates an unrealistic environment in which none of the newly eligible students who would be guaranteed admission or would have had their admissions probability go up by a great deal decide to apply. So that means we're never adding newly eligible students to the pool who might be less qualified, and also we're never changing the racial and ethnic composition of the applicant pool because we're keeping it the same.

And that's -- this is terribly unrealistic. Certainly has not happened in other states like Texas and California where plans have been changed to race-neutral alternatives; the admissions pool does change.

But, more importantly, this assumption creates a kind of mechanical effect, that Mr. Kahlenberg's simulations tend to have very similar racial and ethnic diversity to the actual admitted pool, and they tend to have very similar test scores to the actual admitted applicant, because if you keep all of the students the same and you just change the purported admissions process, there's -- the admissions -- the pool of

admits is only going to change. So we see that all the time in Mr. Kahlenberg's simulations that assume that the pool of applicants doesn't change.

Q. What other criticism do you have with respect to Mr. Kahlenberg's general approach to SES-based simulations?

A. Well, my second main criticism is just that the boosts for having -- having low SES, which he -- he defines in various different ways, depending on his simulation; but in each case, the boost to having low SES is extremely large, unrealistically large, so large that it would essentially remove the ability of UNC to practice holistic admissions at all. In some cases, the boost is so great that a student would, in effect, have hundreds of SAT points added to his or her composite ACT score, in the 400, 500 range -- it depends on the simulation, but it could be as high as 800 points added to the student's SAT score.

Q. And what's your final criticism of Mr. Kahlenberg's simulations?

A. I'm not sure this is my final criticism, but another important criticism of Mr. Kahlenberg's SES simulations is that I do not believe that the question at hand is whether an SES plan can boost socioeconomic diversity. I believe that the question at hand is whether an SES-based plan can attain the current levels of racial and ethnic diversity in academic preparation.

I think there's no doubt in my mind that an SES-based plan that gives very large boosts to students who are low SES could indeed change the socioeconomic composition of UNC's class. And I am not the one who is at all adverse thinking about the importance of socioeconomic diversity, but that does not appear to be the question at hand.

Q. So to summarize on socioeconomic status-based plans, do you disagree with the general logic of such a simulation?

A. I believe that all of Mr. Kahlenberg's SES-based simulations are misleading and that they do not lead us to evidence on which we could reliably, you know, indicate to UNC that it could have an SES-based plan. I think they're just wrong in some of their assumptions and would potentially send UNC down a path that would -- where it would not get at all what Mr. Kahlenberg predicts.

Q. Turning now to another category of race-neutral alternatives that you tested, let's talk about place-based race-neutral alternatives.

And turning to Slide 36, I think a percentage plan is probably a little simpler than what we've just discussed, but as a general matter, what is a top X percent plan?

A. Well, the most famous top X percent plan in the United States is Texas' top 10 percent plan in which students who are ranked in the top 10 percent of their high school class are automatically admitted to the Texas flagship universities,

Texas A&M or University of Texas at Austin. So it's a very clear plan. That's normally what people think of when they think of a top X percent plan. It defines a group of students, and they get automatic admission, assuming that they can show that they are in the top X percent.

The reason why I've kept using the word "X" is that we don't know what that percentage would be before we actually look at the data for a state because what might be possible in Texas with top 10 percent might not be possible in North Carolina because it just has a different population and the size of its state flagship university is different as well. So it really just depends on the number of students who are eligible and the number of seats that are available at the flagship university.

Q. So you ran a top X percent plan and used the top 7.95 percent for admitted students; is that right?

A. That's correct, yes.

Q. And that's shown on Slide 38?

A. It is.

That 7.95 percent was picked so that we would fill the normal number of admission places or slots at UNC. So the 7.95 percent is not arbitrary; it's just a number that comes out if we're trying to fill all those admission slots with top-ranked students in North Carolina high schools. And that's what I'm showing on this chart.

Q. So having admitted the top 7.9 percent of North Carolina public high school students, what happens to the average test score under this simulation?

A. So the test score of an average student who is admitted at UNC drops by 77 points, not exactly the same across different racial and ethnic groups. For instance, if we look under African American, African Americans' test scores dropped by 129 points and Hispanic students' test scores dropped by 99 points. You'll notice the changes for white and Asian students are smaller.

Q. Now, if we look at the bottom blue bars showing the results of racial diversity, walk us through what would happen under this 7.95 percent plan.

A. So under this 7.95 percentage plan, the prediction is that there would be sort of mixed results on racial and ethnic diversity. I think it's first worthwhile looking at the underrepresented minority students, and you'll see there that there are 67 more African Americans predicted to be admitted but fewer Hispanic students and fewer Native American students, so those almost offset one another so that the total number of URMs is not actually changing very much.

If we add up all of those categories, you will see that there are more white students admitted and fewer Asian American students admitted; and while those don't completely offset one another, though, they do somewhat offset one another. So,

again, not a big change in the total number of the combined group of white and Asian American students. So just a sort of mixed pattern of results overall.

Q. As a general matter, what is the necessary precondition for a percentage plan like this to be able to produce racial diversity?

A. The logic of a percentage plan like this is that students are segregated in their high schools. If every African American student attended an all-African American high school and every Hispanic student attended an all-Hispanic high school, and so on for each one of the other racial and ethnic groups, then when we admitted 7.95 percent of the students from each high school, what we would end up doing is representing the racial and ethnic diversity of the state of North Carolina. That's just -- it's a matter of math, basically. It's just the math behind it.

Now, the reason why that 7.95 percent plan does not end up giving us something that looks just like the racial and ethnic composition of students in North Carolina is that students are not attending all one-race, one-ethnicity high school in the state of North Carolina.

Q. Let's turn now to the percentage plan that you simulated with respect to enrolled students on Slide 39.

A. Ms. Flath, may I point out, with regard to the last point that we were making about high schools, that the more

desegregated North Carolina's high schools become in the future, the worse that a plan like this would work in terms of achieving racial and ethnic diversity.

So these plans really do depend not only on having a high level of segregation currently, but also maintaining that high level of segregation into the future.

So I just wanted to make clear that that's an important point, in my opinion.

Q. Thank you.

A. So the --

Q. So let's look now -- 7.95 changes to 7.29; is that right?

A. That's correct because we're now looking at enrolled students. So when we look at enrolled students, we have to change the percentage a little bit to make the percentage of students who are automatically eligible under the plan fit into the number of seats that UNC has, but I don't think that difference between 7.59 and 7.29 is terribly important.

Q. And what happens to the average test scores for enrolled students under a percentage plan?

A. For enrolled students, the average student has test scores that are 76 points lower. Again, I think it's really worthwhile looking at the differences for some different racial groups. For instance, African Americans' test scores fall by 122 SAT points and Hispanics fall by 96 SAT points. Both whites and Asians have smaller decreases in their test scores

of 63 points for whites to 39 points for Asian Americans.
Q. And what happens to racial diversity under this simulation?
A. Under this simulation, much as with the admitted students at whom we were looking on the previous slide, we have a sort of mixed bag of results. There are 55 more African Americans, but that's somewhat offset by a fall in the number of Hispanics and Native Americans. They don't completely offset one another, but there isn't a very big change in URMs overall. And then whites and Asians also largely offset one another so that there is hardly any change in the number of whites and Asians in the class if you look at them as a group, although there's something of a little trade between whites and Asians there. But, overall, race and ethnic diversity really doesn't change much.
Q. Let's talk specifically now about Mr. Kahlenberg's percentage plans.
And on Slide 40, you refer to percentage in quotes. Why is that?
A. Well, because Mr. Kahlenberg's main percentage plan is one that is not based on class rank, for instance, like the Texas plan or other plans in the United States or the ones that I was considering. Instead, what Mr. Kahlenberg is assuming is that UNC estimates Professor Arcidiacono's Model 4 and then applies that model to the students who apply to UNC, only the students who apply to UNC. There are never ever any other students

considered in this top X percent plan.

Those students are then ranked according to Professor Arcidiacono's Model 4 prediction of their probability of being admitted to UNC. So just think of it as largely an academic index, mostly just test scores and grades.

And then he says -- Mr. Kahlenberg says, Let's take the top X percent of students based on this model-based prediction. I think it's just as easy to think of it as maybe being just test scores and grades. He admits them based in that order for each high school. So for each high school, it might be 4.5 percent -- the top 4.5 percent of that high school, but based on that index that only UNC can compute. So this is not based on something that a high school itself would actually know or that a student himself or herself would actually know because it has to be computed by UNC essentially.

Q. Are you aware of any university that has implemented a top X percent plan that is not based on high school class rank?

A. No. And the type of plan that Mr. Kahlenberg is assuming could be implemented is problematic in the following way: If the student does not actually apply to UNC, then the UNC index cannot be computed. So all the students in the state of North Carolina -- or at least all those who thought they had some plausible possibility of being admitted to UNC would need to apply first, have UNC make this calculation first, then UNC would presumably have to report it to the high school and tell

the high school, These students in your high school are automatically eligible for admission at UNC and these other students are not.

So that's one of the reasons why I do not think this is a realistic plan to implement, because it does require the application of massive numbers of students to UNC and then UNC actually doing this modeling before getting back to the students and telling them whether they're eligible or not or for admission.

Q. When you say that Mr. Kahlenberg fails to properly account for capacity constraints, what do you mean?

A. I mean that in conducting this model, Mr. Kahlenberg did not take account of the fact that UNC cannot admit -- it has a certain limited capacity to admit students and to enroll students. It does not have an expendable or contractible number of seats, and that sort of reasoning or that sort of logic was not incorporated in his percent plans so that they have a kind of unrealistic way of coming up with numbers that are based on -- that a class that could be far too large or too small.

Q. And, finally, when you say Mr. Kahlenberg overweights test score and GPA when completing the class, what do you mean?

A. Well, Mr. Kahlenberg has some of the same -- the same issue arises in Mr. Kahlenberg's simulation as the rows in some of my simulations. In other words, we admit some students because

they qualify under the disadvantaged stage of the process. In his case, they're admitted through this top 4.5 percent, say, based on the UNC index; but then that's not enough students to fill out the UNC class, so he needs to complete the class by some means. And instead of trying to do that in a realistic way, the way I tried to do it using students who were admitted to UNC because I know that they are the sort of students who UNC would like to have in its class -- instead, he just ranked students according to their grades and test scores, equally weighted grades and test scores, and just numbers them in order from the top student with top grades and test scores in North Carolina just going on down, and then he just completes the class like that.

Now, the problem with doing that is that it assumes that every single person in North Carolina with top grades and test scores would apply to UNC and that they would always be admitted to UNC, and we know that neither of those things is true.

Q. Let's turn now to the other form of a place-based race-neutral approach, a geography-based plan.

To your knowledge, has any university implemented a strictly geography-based admissions plan?

A. No.

Q. So this is entirely theoretical?

A. This is entirely theoretical, and it's not just

theoretical, but it's actually quite difficult to think about how you would implement such a geography-based plan. I did want to consider geography-based plans carefully, but we had to spend a great deal of time thinking about how could you actually implement such a plan because many of the sort of vague proposals that are out there in the ether are not actually at all realistic or implemental. So we tried really hard to come up with the best -- the best implementation we possibly could given the suggestions that have been made.

Q. And so if a percentage plan, a top X percent plan, uses a high school as its geography measure, what do these broader geography-based plans use?

A. In some ways the idea of the high school class rank-based plans are very helpful for thinking about these geography-based plans because they try in some ways to mimic this high school idea: Instead of using a high school and ranking students, we're going to take a small level of geography and rank students. Sometimes people suggest that ZIP codes are used or those ZIP-plus-four codes are used, but those turn out to be impossible to use. We looked into that. There are just too many ZIP codes basically.

But a census track could be used. A census track is a well-defined unit of geography. It corresponds to a large neighborhood in the United States, and the Census designs tracks very deliberately, so that they, in fact, do have some

amount of neighborhood integrity. So it is a pretty good geographic unit to use.

Once we have a census track, then we still need to order students from top rank on down and then admit students in that same order.

Now, the difficulty -- if I might go on?

Q. Please do.

A. The difficulty is, of course, that not all students in a census track attend the same high school, so they don't actually have -- they're not all ranked in the same class with one another. Some of them might attend one high school, and the others might attend another high school. So now we have to rank students on something.

So what I ranked them on was a combination of test scores and grades equally weighted, and this tends to favor the geography-based plans' ability to attain the actuals in terms of academic preparation. As you can see, we're really just choosing students based on their grades and test scores, so the people who are admitted under the geography-based plan are going to look like they have high levels of academic preparedness.

Q. And turning to Slide 42, I think you basically just walked us through that process. Is that what you did to test this Census Track plan?

A. Yes. Here is the idea. I also need to give some

priority -- the idea of a geography-based plan -- I should take us a step back just so that we all understand what the logic of it is.

The idea of a census track plan or any geography-based plan is that coming from certain neighborhoods in the state of North Carolina puts a student at a disadvantage, and that the way we understand how disadvantaged this student is is by looking at the historical admissions rate to UNC among well-qualified applicants.

So, for instance, let's say we found a neighborhood and even though it had numerous well-qualified potential applicants in the past, students were not applying to UNC, or they were not getting admitted to UNC. So that's its historical admissions.

And the way that a geography-based plan works is that you take the census tracks, or neighborhoods, that are most disadvantaged based on this measure, and you give them first priority. So we're first going to take students from those most disadvantaged census tracks, and then we're going to move through the other census tracks from the most disadvantaged to the most advantaged. We keep taking students from the top of each one of those census tracks until we fill up all of the seats at UNC.

Q. And having done this, what were the results of your simulation using census tracks?

A. So it's a very significant decrease in the racial diversity of UNC's admitted group of students and enrolled group of students.

Q. So the other geographic simulation that you ran replaced the census track with a race-predicting index; is that correct?

A. Yes. So I tried to -- to be clear, the first geographic plan that I tested was really suggested by the complaint and some articles that have been referenced in the complaint. So I took what was in those articles and tried to implement it. But just because it was referenced in the complaint doesn't mean it could be the most successful geographic-based race-neutral alternative.

So then in my Simulation No. 2, I said to myself, Well, let's forget about exactly what was referenced in the complaint. Maybe that wasn't the most successful geographic plan. After all, it was purely theoretical. I'm going to try to come up with the most successful geography-based plan that I possibly can, and by that I mean, I am again going to create a race-predicting index to maximize the number of the nonrace variables for race and ethnicity, but now I'm also going to use geography variables.

So I added in a bunch of geography variables to that earlier race-predicting index to make it not just sensitive to socioeconomic factors -- they are still there; so socioeconomic factors are being considered -- but, in addition, there are a

lot of geography factors that are being considered now.
Q. And as a result of your simulation using this race-predicting index, including geography variables, what did you conclude?
A. Again, I concluded that UNC would see significant decrease in racial diversity in both its admitted class and its enrolled class.
Q. And you talked earlier about the logic of a percentage plan and that it will only produce racial diversity if the underlying community remains racially segregated.
How does that principle apply to these broader geography-based race-control alternatives?
A. Yes, there is a definite analogous logic. Again, it's all based on the logic of segregation. If every black student lived in an all-black census track and every white student lived in an all-white census track, and so on for Hispanics and Asians, and Native Americans and so on, then when we did a geography-based plan, such as the first one I examined, the first simulation, what we would find was that UNC's class would have the same racial and ethnic composition as North Carolina's student population, and that's because of that segregation. That's just a matter -- it's just a matter of the math. It would just pop out.
So if North Carolina has desegregated census tracks, that's the reason why these geographic plans do not -- do not allow

UNC to mimic the racial composition of North Carolina's students. Also, for this same reason, it means that the more North Carolina becomes desegregated over time, the more such a plan would automatically break down in terms of its ability to attain racial and ethnic diversity at UNC.

Q. Thank you.

So, Professor Hoxby, just to summarize where we are, we've now touched upon each of the categories of race-neutral alternative simulations that you ran affirmatively.

Did Mr. Kahlenberg suggest additional concepts or strategies that you also evaluated empirically?

A. Yes. Each additional strategy that he suggested I attempted to evaluate as well as I possibly could.

Q. And is that reflected on Slide 45?

A. Yes. So perhaps I could go over the first one briefly.

Q. That would be great.

A. The first one -- the first one that Mr. Kahlenberg suggested was that UNC could make partnerships with disadvantaged high schools. I believe that UNC's staff may have already discussed a relationship like that.

But when I tried to do a prediction, I wanted to create a specific type of simulation to try to see what could be achieved -- what could be achieved under such a plan. So I did 16 different simulations focusing on disadvantaged high schools that had been judged to be disadvantaged based on my previous

SES indicators, though I was deliberately saying, Let's find out -- Let's find which are the low SES on average high schools in North Carolina; let's assume that UNC does partnerships with them; let's assume that UNC is available to draw an unusually large number of students from those high schools and bring in those students to UNC.

And what ends up happening under scenarios like that is that UNC has an admitted class and an enrolled class with substantially lower test scores.

Q. And what was the other strategy suggested by Mr. Kahlenberg that you tested on an empirical basis?

A. The other the simulation that I tested was the idea that community college transfers would account for a large share of the UNC class. And here I was being very generous with this race-neutral alternative in the sense that I assumed that of all of the students who expressed an intention to go to community college in the NCERDC data instead of going to a four-year college or university, that UNC would be able to find all of the most well-qualified community college students in this state and get all of them to transfer to UNC, so starting with the most well-qualified community college students and then just, you know, working its way down to fill up some of its seats with community college transfer students.

So this was very generous to the community college plan, and, nevertheless, it still resulted in substantially lower

test scores for the UNC class.
Q. And did you also look at potential transfers from North Carolina State University?
A. Yes, I did, because I considered that to be the -- the other university in the state of North Carolina where there might be the most students who would be qualified to go to UNC, but who, for whatever reason, would not have applied or been admitted to UNC.
So this would be -- it's a less aggressive plan in some ways than the community college transfer plan because we're talking about another, you know, wonderful state public university; but even so, if, instead, UNC went and tried to pick up all of the best qualified students from North Carolina State University and bring them to UNC, it would still result in substantially lower test scores.
Q. So, Professor Hoxby, after this exhaustive approach to simulations, did you find any that reached the actual levels of underrepresented minorities and average test scores achieved by UNC through its race-conscious holistic admissions process?
A. I tested 109 simulations, and I was never able to achieve the actuals. In other words, both (indiscernible).
(Court reporter requests clarification.)
Q. Professor Hoxby, if you could repeat that just after "the actuals."
A. In my 109 simulations, I was never able to achieve UNC's

actual levels of racial and ethnic ethnicity and its level of academic preparation as measured by test scores, and this was despite my making very generous assumptions that were favorable to the race-neutral alternatives, so that I thought I was really estimating what I would call the ceiling of what was possible -- realistically possible to reach a race-neutral alternative.

Q. Thank you.

All right. My final topic to cover with you: Your research is cited in the complaint, is that right, some of your prior research?

A. That's correct, yes.

Q. And so let's -- actually, we'll pull up complaint paragraph 126.

And, Professor Hoxby, with the limitations of technology -- we would normally show this to you on the screen. I'll read it just for ease.

Paragraph 126 states: "One study found that between 25,000 and 35,000 socioeconomically disadvantaged high school seniors obtain an SAT or ACT in the 90th percentile or higher and had a GPA of A minus or better. Nearly 6 percent of this group is African American and nearly 8 percent is Hispanic. A great many of these socioeconomically disadvantaged students 'undermatch' by applying to and enrolling at colleges and universities less selective than the ones to which they could

have been admitted."

And that cites an article written by Caroline Hoxby and Christopher Avery entitled "The Missing One-Offs."

Do you agree with the Plaintiff's application of your research to the allegations here?

A. Well, I don't think that that paragraph is a mischaracterization of my research, if that's the question. Maybe you can help me more with the question.

Q. Does your prior research support the Plaintiff's allegation that UNC could use a race-neutral alternative to achieve racial diversity?

A. No, it could not. So there are two reasons why.

The first reason is something that came up in the paragraph that you read, and both in the United States overall and in North Carolina, which is -- I did not investigate North Carolina by itself in that particular paper -- you can see that the vast majority of the students who fit into this category of being high-achieving students who do not apply to selective colleges and universities at present are not underrepresented minorities. That's true overall in the United States, and it's true also in the state of North Carolina where the vast majority of the so-called one-offs are -- 86 percent of them are non-URMs.

So, therefore, if you just go and recruit from the pool of missing one-offs, you will get some underrepresented

minorities, yes, but you will also get a great many non-underrepresented minorities. And, in fact, if we look at the percentage of one-offs from the state of North Carolina who are underrepresented minorities, it is less than the share of underrepresented minorities in the current UNC class.

So if we -- if we just -- if we think about it this way for a moment -- let's say we take one student randomly out of UNC and we replace that student with a student who comes from this pool of missing one-offs. We will systematically be reducing the racial and ethnic diversity of UNC, because the student whom we pulled out at random is more likely to have been an underrepresented minority than the student from this pool. So it -- in and of itself, this cannot be the solution to the -- as a race-neutral alternative.

Q. Thank you.

MS. FLATH: Your Honor, no further questions at this time.

THE COURT: All right. Yes, sir.

MR. MCCARTHY: Your Honor, we need to get our IT person in here and set up. Would you like to take the afternoon break now? It will just take five minutes for the IT person to come in and get situated.

THE COURT: We will take our break, and that will allow you to go straight through with your examination of her. So why don't we take a 15-minute break at this point. So we

will resume at 20 minutes before. All right.

(An afternoon recess was taken from 2:21 p.m. until 2:40 p.m.; all parties present.)

THE COURT: Yes, sir.

MR. MCCARTHY: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. MCCARTHY:

Q. Good afternoon, Dr. Hoxby.

A. Good afternoon, Mr. McCarthy.

Q. Can you hear me okay?

A. Yes, I can hear you very well.

Q. Great. I sometimes have a habit of talking too quickly, which Ms. Russell has reminded me of, and I will try not to do so that hopefully you can hear me.

If at any point you have trouble, please let me know and I'll do my best to do a better job of speaking clearly and slowly.

A. I will. Thank you.

Q. I'd like to first discuss race-neutral alternatives.

You are not offering any opinion on whether any particular race-neutral alternative is workable for UNC, correct?

A. I was asked to opine on the question of whether any workable race-neutral alternative could attain UNC's current actuals in terms of ethnic diversity and academic preparedness.

Q. Understood.

And I think we had a discussion similar to this at your deposition. And you are not offering an opinion on whether UNC actually could or should adopt a plan that might be slightly lower or higher than its actuals, correct?
A. What I've tried to opine on and talk about is whether I am aware or can find any workable race-neutral plan that attains UNC's current actuals in terms of racial and ethnic diversity and academic preparation.
Q. So it's about whether they meet the actuals? That's what your opinion is about, correct?
A. Correct. That's what I was asked to find evidence on.
Q. Okay. I just want to make sure of this because there are places, for example -- as you may remember, we discussed in your deposition -- for example, at page 4 of your reply report, you say: "No workable race-blind alternatives exist at UNC." But in your deposition, you clarified that you were not offering any opinion on whether any particular race-neutral alternative is workable. You were just opining on whether or not race-neutral alternatives you considered met UNC's actuals in terms of academic preparedness and racial diversity; is that correct?
A. I'm not sure what the difference is, but -- between your last question and this question, but what I was asked to consider was could I find a workable race-neutral alternative that would meet UNC's actuals in terms of its racial and ethnic

diversity and academic preparedness, and that is what I attempted to do.

Q. Okay. I have a little bit of an issue with the word "workable," because I asked you about that several times at your deposition. And you said that you couldn't answer as to workability, and now it seems today that you're putting that word back in.

Are you trying to offer an opinion today on whether or not any particular race-neutral alternative is workable for UNC?

A. When I use the word "workable," I have a definition in my head, which is that it must be a plan that is based on data that are actually available and that could plausibly be implemented by UNC's Office of Admissions. Even if it would be very difficult for them to implement, I would still consider it to be workable dependent on available data and if it were a plan that would (indiscernible).

(Court reporter requests clarification.)

Q. If you could you repeat the last of your answer, Dr. Hoxby.

A. I'll try to repeat it as exactly as I can.

What I meant by my definition of workable was that the plan had to be based on data that are actually available, and it had to be a plan that could be implemented by UNC's Office of Admissions. Even if it were difficult for them to implement, it could still be implemented.

Q. Dr. Hoxby, you do remember sitting for your deposition in

this case, correct?
A. Of course, yes.
Q. And afterwards you had an opportunity to review that deposition?
A. Yes.
Q. Okay. And you took an oath to tell the truth at that deposition, correct?
A. Yes.
Q. And afterwards when you reviewed the deposition, you had a chance to sign an errata sheet noting any errors in it?
A. Yes.
Q. Okay. We have a copy of your deposition here. We're going to put it up on the screen, and you should have it next to you. I want you to turn to page 58.
A. If you don't mind, it's just going to take me a moment because I have a lot of --
Q. No problem. Please take your time.
(Pause in the proceedings.)
A. Okay. I am on the right page, I believe.
Q. Okay. You should be on page 58.
A. Does it begin with the words "Race-control alternative."
Q. Yes. Go down to line 22.
MR. MCCARTHY: And I should probably note there's a number of occasions where the deposition says "race-control," and I believe the errata sheet was amended to make them say

"race-neutral." I don't know why that came up several times. So if anyone is confused by race-control in the deposition, I think both sides can fairly say it's race-neutral. And I will read it like that, if that's okay, Your Honor?

THE COURT: That's fine.

Q. (By Mr. McCarthy) So I'm going to read here for a bit, Dr. Hoxby. This starts with me talking.

"Question: But in your report, you do express an opinion on the various race-neutral alternatives you consulted in terms of whether you think that they are workable or not, correct?

"Answer: I evaluate each alternative relative to what UNC attains actually now under its current plan.

"Question: So that's what I'm talking -- sorry. So that's what I'm asking you to do now with a hypothetical one. Let's say we're starting from UNC status quo, and you evaluated a race-neutral alternative that would increase URM representation by 5 percent but decrease SAT scores by an average of a hundred points. Is that one that you would say is workable or not workable?"

Objection from your counsel, and then you answered: "I can't answer that question within my assignment.

"Question: Why not?

"Answer: Because in order to answer that question, I would have to have expertise in knowing what the trade-off between the two -- the two goals were, and that is not in my

assignment."

Were you asked those questions and did you give those answers?

A. Yes.

Q. Okay. Let's move along further to page 63. This is further along in the conversation. If you see at line 7 where it says "Handing you" -- do you see that?

A. Yes.

Q. "Handing you what's been marked as Exhibit No. 3.

"Answer: Yes.

"Question: That is your reply report?

"Answer: Yes, it is.

"Question: Can you turn to page 4 of that report? Do you have that in front of you?

"Answer: Yes.

"Question: Great. Do you see the Subheader B there --

"Answer: Yes.

"Question: -- middle of the page? Great. Can you read that for me?"

And then you read: "No workable race-blind alternative exists for UNC.

"Question: Okay. So before the break, you told me that you were really reporting on how race-neutral alternatives did compare to UNC's actuals but not really expressing opinion as to whether a race-neutral alternative would work or not work."

Objection from counsel.

"Question: But this seems to actually say that they wouldn't work. Am I correct about that?

"Answer: In this context, what I mean is there is no race-blind alternative in which I predicted that UNC could achieve its actuals.

"Question: Okay. So that sentence -- I just want to make sure I understand. What that sentence means is that you have not found a race-neutral alternative that meets UNC's actuals.

"Answer: I have not found a race-blind alternative that is predicted under my analysis to achieve UNC's alternatives.

"Question: Okay. By actuals -- we mentioned before levels of URM representation and SAT scores, but are there other actuals that you had in mind as well?

"Answer: Those are the actuals I looked at throughout my reports.

"Question: Okay. So I just want to understand. What you mean then by B -- that's Subheader B -- I found no race-blind alternative meets UNC's actuals, correct?

"Answer: Correct."

Dr. Hoxby, were you asked those questions, and did you give those answers?

A. Yes.

Q. Thank you. Your opinion is that race is not a dominant factor in UNC admissions, correct?

A. That is my opinion based on the evidence, yes.
Q. And you take issue with the size of the effect of race that Professor Arcidiacono finds at UNC, correct?
A. I take issue with whether the evidence that he provided gives evidence of the true effect of race and ethnicity in the admissions process.
Q. It's your position that race explains only 1.2 percent of admissions decisions, correct?
A. Well, it depends on the model, but in my preferred model, it explains 1.2 percent of the admissions decision; but in some other models, such as Professor Arcidiacono's preferred model, it explains somewhat more, but always less than 10 percent and usually ranges between 1 percent and about 6 percent, depending on the model.
Q. So in your -- okay. At the same time, you conclude that there is no evidence that a race-blind alternative would allow UNC to maintain its current racial diversity and also its current academic standards, correct?
A. I did my absolute best to consider every race-neutral alternative that was suggested or proposed to me, either in the complaint or elsewhere, and none of the race-neutral alternatives I tested attained the current levels of academic preparedness and racial and ethnic diversity.
Q. Your two conclusions are in tension with one another, aren't they, Dr. Hoxby? On the one hand, you conclude that

race has a very small effect in admissions at UNC; and on the other hand, you say it's impossible for a race-neutral alternative to fulfill the job that race is doing. How do those two fit together?

A. Those two conclusions are not at all in tension with one another. And, in fact, as a logical matter, they -- they actually make a lot of sense together, and I would be glad to explain that in a little bit more detail, if you like, just to make sure you understand what I mean.

Q. If race is having only a small effect on admission, it should not be that hard to find a substitute, should it?

A. The first part of your sentence and the second part of your sentence are -- they don't actually go together. So the first part of your sentence is is race and ethnicity only playing a small role in admission? Yes, it is only playing a small role in admission. It's tipping some students who are sort of just on the bubble, as I described previously, from being rejected by the admissions office to being accepted by the admissions office. That could mean it's playing a small role in admissions that's not playing a role for very many students and even then just tipping some back and forth who are close -- who are on the bubble anyway.

The second part of your statement is about whether it is easy to replace race and ethnicity in the admissions process. And the answer to that question is going to be based on whether

there are good proxies for race and ethnicity that can be used instead of race and ethnicity to make even those on-the-bubble types of decisions.

And some of the evidence that we've been examining today has shown that there is no good proxy for race and ethnicity in North Carolina because socioeconomic variables and other variables that we examined, such as geography, are not terribly good at substituting for race and ethnicity. So when we put the blinders on, even if it was only -- it was only affecting a small number of decisions, we now can't get it at all.

Q. Dr. Hoxby, you would agree, wouldn't you, if race was having zero effect on admissions decisions at UNC, then it would be easy to find an alternative for race, correct?

A. I don't see how that question fits together again. So I believe the question was --

Q. I'm sorry. Go ahead.

A. So I believe that your question was, the first part, if race was having zero effect on admissions -- right, that was the first part of the question or the condition? And then the second part of the question, it would be easy to find a race-neutral alternative? Wouldn't the admission process already be race-neutral at that point?

Q. It would be. And if you took race out of the equation, it would make no difference, right?

A. Well, I think you just said it wasn't in the equation.

Q. So the point is this, Dr. Hoxby: The smaller the effect of race, the easier it is to replace in the process, correct?
A. No, that's not correct.
Q. So if the -- if race was having --
A. The --
Q. -- a .1 percent effect on admissions decisions, it might still be hard to replace?
A. You would need to have something that was a proxy that was a good substitute for race and that .1 of the admissions decisions in which it made a difference; and if you didn't have any ability to proxy for it, that .1 of the admissions decisions would surely change. And we don't know what other admissions decisions would also potentially change because it -- you can't just say it's this one -- it's this one person or something like that. It isn't that simple. Race and ethnicity can play a role across the whole pool of applicants, and we don't get to identify the individuals necessarily that it would have tipped them back and forth between admit/reject.
Q. So to be clear, your testimony is if race were affecting only .1 percent of admissions decisions at UNC, it might still be hard to find a race-neutral alternative, correct? That's your testimony?
A. That attained the same actuals in terms of racial and ethnic diversity and academic preparation, yes.
Q. Thank you. I'd like to discuss how you test race-neutral

alternatives. Let's look at your Slide 25.
A. I have it here in front of me.
Q. Great. Thank you.
Your Slide 25 explains how you test race-neutral alternatives, correct?
A. That's correct, yes.
Q. You model a simulation for a race-neutral alternative and then compare its results against UNC actual levels of academic preparedness and underrepresented minority representation, correct?
A. Yes, that's correct.
Q. I want to make sure I understand what you mean by UNC actual levels of academic preparedness and underrepresented minority representation, or, as you sometimes call them, UNC's actuals.
When you compare a race-neutral simulation to UNC's actuals, you are not comparing URMs generally, but, rather, you compare them by specific racial ethnic group, correct?
A. Yes. I tried to break them out into separate racial and ethnic groups, although, of course, you can add up across those groups to get that percentage of URM.
Q. So let's look at your Slide 38.
A. I have it here.
Q. Thank you.
You looked at this slide earlier with Ms. Flath, correct?

A. I did, yes.
Q. Your Slide 38 shows the results of a race-neutral alternative you considered, correct?
A. Yes, it's a percentage plan.
Q. It's a top 7.95 percent plan, correct?
A. Exactly, top 7.95 percent.
Q. Thank you. I might have misspoken. 7.95.
And your results show that plan would yield a higher level of URM representation overall, correct?
A. Yes. There are 67 African Americans added, 8 Hispanics were lost, and 51 Native Americans were lost. So the URMs overall, if we add up all of those categories, could be slightly higher because we added the (indiscernible).
(Court reporter requests clarification.)
Q. Could you repeat that, Dr. Hoxby?
A. Well, there are 67 African Americans added, and there are 59 Native Americans and Hispanics who are lost, so that is a net change of 8 students --
Q. Thank you.
A. -- who are underrepresented minorities.
Q. Thank you. And if you count Pacific Islander, it would be plus 9, correct?
But the point is that those results -- that plan resulted in a higher level of overall URMs, correct?
A. Yes, it did.

Q. And would you say that this plan failed to meet UNC's actuals in terms of underrepresented minority representation?
A. When I talk about the actuals, you'll have noticed that I'm also trying to answer that question that I was asked whether UNC could meet its actuals both in terms of racial and ethnic diversity and academic preparedness at the same time. There are presumably many, many plans that would do well in only one of those two criteria, and the problem is trying to meet them both at the same time.
Q. Understood. And I want to make sure I understand, though, what you mean by meeting UNC's actuals.

Let's assume, for example, that this top 7.95 percent plan -- imagine if you looked at the top of that slide and all of those numbers for SAT scores all went up. Okay.

Do you have that in your head?
A. Of course, yes. Thank you.
Q. Then imagine the bottom half of the slide is exactly the same as it is now. So in that case, it would be easy to see that UNC's SAT scores met their actuals, but what would be your opinion as to whether or not you -- this plan, this hypothetical we're talking about now, would meet UNC's actuals with regard to racial diversity?
A. Well, I would say that the results were somewhat mixed if we look at individual racial and ethnic groups, but that if we just want to look at underrepresented minorities versus not

underrepresented minorities, just that division, and we didn't care about whether people -- students were African American, Hispanic, or Native American -- we didn't care about that at all -- I would say that it had met the actuals in terms of that -- the balance between URMs and non-URMs, and I would say that there was a mixed bag of results when we looked more finely into the racial and ethnic diversity of UNC. And I think that most colleges and universities would probably consider racial and ethnic diversity to be that more complicated look, but -- yes.

Q. So the question [sic] then is yes or no on meeting UNC's actuals? Or you're not sure?

A. Well, it would have met UNC's actual proportion of students who are URM, underrepresented minorities, and it would have met UNC's actuals on African American. It would not have met UNC's actuals on Hispanic or Native American.

Q. I understand.

And I'm trying to understand, I guess -- I'm trying to get a full understanding of the conclusions you're drawing when you're making these comparisons to actuals. So you would give split answers there, or can you give one answer that, yes, UNC met its actuals, or, no, UNC did not meet its actuals?

A. As I think it says on this slide, there are somewhat mixed results on racial diversity; and I think that would be my conclusion, that there are mixed results on racial diversity.

I -- I feel that what I'm required to do is show evidence on how well the plan is able to attain the actuals, and that's a matter of just showing the evidence in a table, and everyone can look at that evidence for him or herself.

Q. And would your opinion be the same with respect to SAT scores if they showed similar mixed results?

A. Well, I don't know that we want to look with SA -- perhaps you can re-ask the question. Do you mean that some groups' SAT scores would have gone up and some of them would have gone down? Is that the question that you're asking?

Q. Yes. Sorry I was unclear.

So image a scenario where some URM groups have average SAT scores going up, some URM groups have average SAT scores going down, but overall URMs as a group have an average SAT score going up.

What would be your opinion as to whether or not that met the actuals?

A. So I think with regard to SAT scores, we want to think a little bit differently about them, and the reason is that it is not -- when we think about academic preparedness across the UNC class -- a comparable class, we are not necessarily concerned with which students have the higher SAT scores and the lower SAT scores, that they average up to some number. So it strikes me that the most important thing about academic preparedness is stretching it over the class as a whole where you can see that

the whole average decreased 77 points. We can (indiscernible).

(Court reporter requests clarification.)

Q. Dr. Hoxby, I'm sorry to interrupt. The court reporter is having a hard time hearing you. Could you back up and start again? I apologize. I know this is difficult, and I appreciate your patience.

A. Okay. I know I'm not a natural slow talker anyway.

Q. All of us suffer from that at times.

A. So in terms of academic preparation, the number that I think of as being the most important number is the total average decrease in SAT scores, or any other measure of academic preparation, but SAT scores here, across the whole of the class, and that's because that is probably our best measure of academic preparation for UNC students.

We might be interested, as a matter of interest, to see what happens to the SAT scores of each separate racial and ethnic group, but I still think that the topline result, most important result, is what it's like on average, because it's not clear why we would say that, for instance, having Hispanics have a small decrease and African Americans having a small increase would necessarily affect the average preparation of the UNC class if those were offsetting one another.

Q. Thank you. So let me -- I just want to make sure I understand your answer. It sounds like -- and I'm not trying to put words in your mouth. I just want to make sure I

understand.

It sounds like you're saying, with regard to academic preparedness and using your metric of average SAT scores, that you would be looking at URMs overall to see whether they went up or down and not necessarily focusing on whether individual racial groups within that set were moving a little bit up or a little bit down? Do I have that right?

A. I think that looking at the individual groups -- racial ethnic groups or looking at URMs versus non-URMs is less important when it comes to academic preparedness because what we're really interested in overall is how the academic preparedness at UNC changed. And I think we care about how it changes among underrepresented minorities and how it changes among nonunderrepresented minorities, but academic preparedness is mainly about academic preparedness.

Q. Thank you.

When you spoke with Ms. Flath earlier in talking about academic preparedness in the context of race-neutral alternatives, you discussed how you do not display the average GPA of the simulated class and compare that against UNC's actuals, correct?

A. That's right; I did discuss that with Ms. Flath.

Q. Mr. Kahlenberg in his simulations does report GPA of the simulated class and the actual class, correct?

A. The admitted class, yes, in his simulations, not the whole

class.
Q. Yes. Sorry. Thank you for the clarification.
He's usually talking about the admitted class is your point, correct?
A. Right. And I don't believe Mr. Kahlenberg ever does any simulations looking at the enrolled class. It's always just the admitteds.
Q. Just to clarify, my question is about whether or not he reports GPA as one of his results when comparing his simulations to UNC's actuals.
And he does, correct?
A. Yes, he does.
Q. Now, when you were speaking with Ms. Flath about how you do not report GPA, I believe your explanation was that different high schools have different grading standards; is that correct?
A. Yes. Yes, that was my explanation.
Q. And that's certainly true with the data that UNC has provided to the parties in this case, correct?
A. Well, UNC's Carolina Connect data, the admissions data, is perhaps not the best way to look at that question. The NCERDC data, which has data for every public high school student in North Carolina, would be our best way to try to understand whether different high schools have different grading systems because it's just a much more comprehensive data set.
Q. Well, you're aware, though, that UNC's applicant data

includes lots of applicants who, for example, have GPAs on something other than a four-point scale, correct?
A. Could you had repeat that question? I'm not sure I got the middle of the question.
Q. Sorry. It's a little long-winded. I'll try to do a better job asking it.
Isn't it true that there are applicants in UNC's applicant data that have GPAs based on six-point scales?
A. Yes, there are a variety of different sorts of grading scales used in North Carolina schools, and some of them are not all a four-point scale.
Q. And you use that GPA variable in your modeling, don't you?
A. Yes, I do use it, but I translate it first into a common scale.
Q. So if you can translate it into a scale that allows it to be compared for the purposes of modeling, why don't you do that with your race-neutral simulations in reporting GPA?
A. That's a good question. So let me explain the difference between those two different -- in the model, GPA is used as one of the factors that can affect a student's chance of admission, but it's being used as one of multiple factors. So when I am considering the effect of GPA in that model, it's what we would call an explanatory variable or explanatory factor.
So think of it this way. Let's say we have a student and the student's SAT scores are combined 1300, and for the student

with a combined 1300, we increase GPA by a bit. That student may be more likely to get in, all else equal, because we're able to hold all the other things equal. We're already taking into account the fact that the student has SAT scores of combined 1300.

So when I use it as an explanatory variable, what the GPA is helping me do is it's helping me see what the admissions officer would have seen: The students with 1300 and with, you know, somewhat higher GPA. So that's fine.

Using it as an outcome variable, which is more like the way that we're using SAT scores now -- something that is based on the race-neutral alternative being put in place -- is very different. When we use something as an outcome variable, it's very important that it be on the same scale for everyone. We wouldn't want you to be judged in centimeters in terms of your height and then judge me in inches in terms of my height and have that be an outcome variable.

But when it's an explanatory variable, as one of many explanatory variables, we could, in fact, have your height be measured in centimeters and my height be measured in inches, and if the model were sufficiently complex, that would actually be okay. I could explain how I could do that in a -- in a complicated model because it's now just one of many factors, and I can take account of those scale differences when I'm holding the other things constant. And a good complex model

would, in fact, allow me to have some people in centimeters and some people in inches.

Of course, that's -- I don't do that here, but it's just to illustrate that it's not the same thing when something is an explanatory factor versus something is the outcome that we're trying to study.

Q. GPA and SAT scores each give more context to the other, don't they?

A. Sure. And I think all is equal to students with the same SAT score. One has a higher GPA, that's probably an indication of something good about the student's academic preparation, probably also the student's motivation and some other things, conscientiousness.

Q. In fact, there is testimony in this case that UNC has found GPA to be more predictive of academic success than test scores, isn't there?

A. I don't know.

Q. And just as you could scale GPA inside the model, you could scale it on the outside, too, even if you're reporting it as an outcome so that you are comparing inches to inches instead of inches to centimeters. You could do that, couldn't you?

A. I am not aware of any standard or highly expected way of rescaling GPAs across high schools with different grading standards so that they are all on the same scale unless we use SAT or ACT scores to help you with the rescaling; in which

case, we're back to SAT scores and ACT scores.
Q. UNC does evaluate candidates based on their GPA, correct?
A. It certainly considers GPA, I believe, as one of the factors in admissions.
Q. And, in fact, they effectively incorporate it into the performance rating, don't they?
A. I believe GPA is one of the factors that goes into the performance rating, yes.
Q. And as you said, it does give context to SAT scores, correct?
A. Yes, that is why I included GPA in my admissions models, because I do believe it belongs in those admissions models because I do believe that admissions officers take it into account.
Q. You're aware that percentage plans typically result in higher GPAs on average, correct?
A. They could. They wouldn't necessarily, but they could because all that is weighted in a percentage plan. And I'm now not talking about Mr. Kahlenberg's plans, but I'm talking about (indiscernible).
(Court reporter requests clarification.)
Q. I'm sorry, Dr. Hoxby. The court reporter is losing you again. I know the technology makes this difficult. We appreciate your patience.
Could you back up?

A. I could. So maybe I'll just start from the top of the answer again because I'm not sure where she lost me --
Q. That's fine.
A. -- the court reporter lost me.
Okay. So in a top X percent plan, such as Texas' top 10 percent plan, the only thing that is taken into account when determining whether a student is eligible for admission is whether the student is in the top 10 percent of his or her high school class. So naturally a plan like that places not some of the weight, but 100 percent of the weight on a student's class rank. Class rank is based on GPA. So it is mechanically based, that a top X percent plan based on class rank alone will, in fact, put a lot of weight on high school GPAs just automatic to those plans.
Q. Thank you. And so that's why percentage plans based on class rank typically result in higher GPAs than the status quo, correct?
A. I would not say typically. I would just say it would be plausible that they could, and we would have to look at data for any given university, because it's important to realize that even in a top 10 percent plan, such as Texas', not everyone who is a top-ranked student actually ends up applying to or enrolling in one of Texas' public flagship universities. So that's why I said it could happen, but it would not necessarily happen.

Q. Let's look at your Slide 29. Do you have it?
A. I have it here.
Q. Great. Your Slide 29 refers to an error rate in your modeling of an SES-based alternative to UNC's use of race in admissions, correct?
A. Yes, that's right.
Q. And that slide indicates that your error rate refers to students identified using the SES variables who are not underrepresented minorities, correct?
A. Yes, it -- I believe that the error rate that is shown here is both what we call Type I error and Type II error. Type I error is when we predict that someone is an URM when the person is not, and Type II error here would be we predict that the person is not an URM when the person is. So this may be a typo on the slide because error rate combines both Type I error and Type II error.
Q. So in the little box on the bottom on the right in red, it doesn't identify both of those kinds of errors. What it says is "Error rate equals student is not URM when socioeconomic variables predict they are." So that's just identifying one kind of error.
A. You're right; that is just identifying one kind of error. And both types of error, I believe, are represented on this slide.
Q. So that little explanation in the red box is a mistake?

A. I think it should be corrected to read that "The error takes place when a student who is not an URM is identified as URM, or a student is not identified as being URM when, in fact, they are URM." I hope I said that correctly. Type I and Type II error are always a little bit confusing to state back to back.

Q. They confuse me sometimes too. I try not to use them.

But let's look at the title of this slide: "Socioeconomic Status is not an Effective Proxy for Race." So you are explaining that using SES sometimes does not hit URMs, correct?

A. What we care about when we're trying to predict a race is what percentage of the time do we get it right, essentially. Do we predict the correct race based on SES variables? And so we care about both types of error: Both people who are URMs not being identified as URMs and people who are not URMs being identified as URMs.

Q. Let's take a look at your opening report. I'll give you the page. I know it might take you a minute to find it. I'd like you to turn to page 48. We'll pull it up.

A. Mr. McCarthy, could you read me just the top few words of that page to make sure I'm on the same page?

Q. Sure. On page -- go ahead.

A. Is paragraph No. 132 the first paragraph that you see on that page?

Q. I'm looking at two pages after that. Sorry. If you're

looking on our video screen, it might be counting the pages of the PDF. The actual page number on the bottom right corner should be 48, and the first two words at the top of the page say "Price Lunch."

A. Okay. We're on the same page. Thank you.

Q. Thank you. So I'd like you to look at paragraph 136. And I'll read just the first two sentences there -- I'm sorry -- the first three sentences.

"It is useful to explain how this analysis relates to alternative admissions plans. A less than perfectly correlated proxy for race and ethnicity will generate false positives and false negatives. A false positive is a student who is falsely identified as an URM by the proxy."

Did I read that correctly?

A. Yes, you did.

Q. Thank you. Now, I don't want to get mixed up between Type I and Type II because I get mixed up on that sometimes, but I want to focus here on whichever one of those is the false positive.

A false positive is a student who is falsely identified as a URM by the proxy. So would you consider it a false positive if an SES-based diversity approach produced candidates who were, in fact, of lower SES status?

A. A false positive in terms of race or a false positive in terms of SES status?

Q. You tell me.
A. Well, SES indicators are good at identifying students who are higher or lower in SES, and so the better your SES variables, probably the better you're going to do in identifying students who are really low SES or really high SES, and that's sort of the nature of using a lot of good SES variables.
In terms of predicting race and ethnicity, though, that's really what I've been asked to do is to try and see whether there's a race-blind proxy that would help UNC substitute for race and ethnicity in the admissions process.
Q. So your models of SES -- your -- sorry. Strike that.
Your models of SES-based simulations were testing for racial diversity but not for SES diversity, correct?
A. Yes, I was asked to test -- see whether UNC could choose -- could attain -- sorry -- its racial and ethnic diversity and its current level of academic preparedness.
Q. So your assignment here was not to consider the benefits of diversity beyond racial diversity, correct?
A. That was not in my assignment, no.
Q. You are aware that UNC officials have testified here that SES diversity is very important to the university, correct?
A. I'm not aware of that specific testimony, but I am aware of the fact that UNC has at various times made statements that would suggest that socioeconomic diversity was desirable in the

class.
Q. UNC actually claims to prioritize SES diversity as a, quote, critical component of an institution's broader obligation to the state of North Carolina, correct?
A. I assume that the quotation that you've given me is correct, yes, Mr. McCarthy.
Q. But, again, you never analyzed in your race-neutral alternatives how they would advance socioeconomic diversity, correct?
A. That is not in my assignment.
Q. You were instructed not to look at that, correct?
A. I don't know that anyone instructed me not to look at it. I did not look at it.
Q. You remember giving a deposition, right?
A. Yes.
Q. And we talked before. You've had a chance to review that deposition after you took it under oath, and you reviewed it and you signed an errata sheet, correct?
A. Yes.
Q. Okay. I'd like you to turn -- pull out your deposition. I'll wait for you to pull it out, and let me know once you get it and I'll direct you where to go.
A. I think I have my deposition now.
Q. Great. Please turn to page 39.
A. Yes, I have it.

Q. And let's -- let's actually start up at 12. And this is in the context of the university's statements about SES diversity. I'm going to go ahead and read this. Okay?
A. Yes, go ahead.
Q. "Question: So I don't mean to ask you if you saw this particular version of this statement with regard to socioeconomic status, but you became aware of the university's position with regard to socioeconomic diversity during your work in this case?
"Answer: Correct.
"Question: Okay. After you got your assignment?
"Answer: That's correct.
"Question: Did that make you reconsider your assignment, whether you should consider to what extent race-neutral alternatives advance socioeconomic diversity?"
There was an objection from counsel, and then your answer: "I did not have a change in my assignment."
Were you asked those questions, and did you give those answers?
A. Yes.
Q. On the topic of SES status, you testified this morning that SES status does not correlate with race in North Carolina, correct?
A. Well, it does correlate with race in North Carolina. It is not highly correlated with race in North Carolina. So as an

example, one SES indicator is parents' income. Parents' income is correlated with race in North Carolina, but it is not so highly correlated with race in North Carolina that I can use family income as a good proxy for a student's race and ethnicity. These things are correlated, but not highly correlated. What matters is the degree of correlation.

Q. What would tell you the degree of correlation?

A. Well, it's a statistic that is very easily computed, and that's essentially what I'm doing in my opening expert report is that I'm reporting those correlations I called multiple correlations because, in fact, I'm considering a lot of socioeconomic factors together. I'm not just considering parents' income, for instance, but I am considering parents' income, parents' education, neighborhood variables, things like that.

So it's a multiple correlation, but it's still a correlation -- it's a type of correlation. It's just that you're looking at all of these pieces together and trying to understand how each one of them is correlated with race and ethnicity while also considering the other ones at the same time. That's the beauty of a multiple regression.

Q. Fee waiver and first-generation college are commonly thought of as SES variables, correct?

A. Sorry. The first one was fee waiver. And the second one was?

Q. First-generation college?
A. Yeah, they are often used by sociologists as SES indicators. Obviously, if you're first-generation college, your parents do not have a college education. The fee waiver is a little bit different because fee waivers -- all students who are below a certain income level are eligible for fee waivers. Not all students with below income level actually take them up. So it is an indicator, but it is by no means a perfect indicator of SES.
Q. And so you just made the point, I think, that fee waiver actually tends to underreport SES status a little bit, correct?
A. Yes. There are some low SES students who do not actually use fee waivers. I would say that a fee waiver is a kind of combination of the students being eligible and the student had a high school counselor or high school teacher or someone else who is sophisticated enough to recommend to them that they ask for a fee waiver in the application process.
Q. Are you aware that more than a third of URM North Carolina applicants to UNC are first-generation college and more than a third are fee waiver applicants?
A. I was not aware of those specific numbers. If you say that those are the correct numbers, then I will assume that you are correct.
Q. Let's look at Professor Arcidiacono's opening report. If we go to page 22 -- we can have this put on the screen for you.

(Discussion between counsel.)
Q. Page 22 of Professor Arcidiacono's opening report.
A. I have it in front of me. Thank you.
Q. Great. So if you turn to page 22, you will see a table of summary statistics for in-state applicants. If we look under African American in the column headed "Total," that signifies all African American applicants from North Carolina. And if we go down three rows from there, you'll see first-generation college, and that indicates that 39.2 percent of African American applicants from North Carolina are first-generation college.
Do you see that?
A. Yes, I see that number.
Q. And if you go down another two rows, that's the row for fee waiver. 43.46 percent of African American applicants from North Carolina are fee waiver applicants.
Do you see that?
A. Yes, I see that number.
Q. And as we just discussed, fee waiver actually underreports on SES status sometimes, correct?
A. Yes, it does sometimes, although I'm not sure whether the group that I expected (indiscernible).
(Court reporter requests clarification.)
Q. Okay. Could you repeat that last part? I think the court reporter had a hard time hearing you.

A. I'm not sure if I were thinking about fee waiver -- fee waivers underrepresenting a student's eligibility for a fee waiver, but I would expect that understatement to be greater for African American. If anything, in North Carolina I would expect it to undercount eligibility for fee waivers most in rural western North Carolina where you have a lot of small schools, rural schools. That's where you would probably find somewhat less knowledgeable high school counselors and teachers who would not necessarily know about the fee waivers.

Q. Thank you.

If we look over underneath Hispanic in the total column there, again, that signifies all Hispanic applicants from North Carolina. And you go down three rows to the first-generation college row. That says that 46.73 percent of Hispanic applicants from North Carolina are first-generation college.

Do you see that?

A. Yes, that's right.

Q. And then if you go down two more rows to the fee waiver spot again, we see that 33.1 percent of Hispanic applicants from North Carolina are fee waiver applicants, correct?

A. Yes, that's what's shown in the table.

Q. Thank you.

I'm going to talk about a different subject.

You opined that changing the admissions process to replace

UNC's racial preferences with some other race-neutral alternative could change the nature of the applicant pool, correct?

A. Yes, I would expect any alternative admissions plan to change the nature of the applicant pool.

Q. In particular, you've stated that non-disadvantaged URM applicants would be less likely to apply under a hypothetical race-blind admissions than they currently are, correct?

A. Yes, that is a reasonable prediction.

Q. And in your view, students are less likely to apply if they believe that they are less likely to be admitted, correct?

A. Yes, because applying to a college or university takes some time and effort. So if I believe I have a very low probability of being admitted, I'm less likely to just go through that type of effort as long as I can apply to other colleges using that kind of effort instead.

Q. So it's your view, then, that URM students who believe they are less likely to be admitted would be less likely to apply if UNC were to replace its racial preferences with a race-neutral alternative, correct?

A. I believe that any student who thought that his or her probability of being admitted to UNC had been decreased by the new alternative admissions plan -- race-neutral alternative admissions plan would be less likely to apply. That doesn't mean, you know, every student who has a decreased probability

of being admitted would decide not to apply, but there would probably be some reduction in the probability of applying by students who were disfavored by the new alternative admissions plan.

Q. In your view, then, the URM applicants that would be less likely to apply under a race-neutral system would be the weaker ones relative to the overall pool of URM applicants, correct?

A. No, no, no, it's not that simple. I'll give you an example, and then I'll explain the logic.

The example might be the state of Texas or, for that matter, maybe University of California at Berkeley. And so when Texas or California moved to top X percent plans or race-neutral plans, the students -- some students realized that they would have a lower chance of admission at one of those flagship universities.

For instance, let's say that I were a high-scoring student and I had gone to a very competitive high school. So even though I have gotten really good grades; I have good extracurriculars; I have high test scores, I was at the 12th percentile in my high school in the state of Texas. So I'm a person who is not likely to get into the University of Texas or Texas A&M. That sort of student is less likely to apply.

It's worth noting, though, that that student is not particularly underqualified. In fact, part of the reason why that student might not apply is that that student has good

outside opportunities; in other words, good opportunities outside of University of Texas and Texas A&M.

So, in fact, when you change to a race-neutral alternative and you're predicting who is going to apply to the school, generally speaking, the people who are going to have their admissions chances reduced will be less likely to apply, and the people who have their admissions chances increased will be more likely to apply; but it is not the case that the people who have their admissions chances reduced are particularly low achievers or have low academic grades. In fact, it often goes the opposite direction.

Q. I want to make sure I understand. Actually, strike that.

Did you do any modeling to predict how the applicant pool might change under these various race-neutral alternatives?

A. What I did was try to make a very generous assumption about who would apply under the race-neutral alternatives. So, yes, we did look at the data to try to understand what percentage of newly eligible North Carolina -- in other words, well-qualified North Carolina students would apply, but we -- there's no way, really, to model this perfectly.

So what we did was we looked at data from other states that changed to race-neutral plans, and we looked at data from the state of North Carolina to try to get a generous answer to this question, knowing that until you actually do it and switch to a race-neutral alternative, you're probably not going to know

exactly how the applicant pool would change. So I tried to just be generous.

Q. Thank you. My question --

A. (Indiscernible.)

(Court reporter requests clarification.)

Q. I didn't hear you, and I'm not sure the court reporter did. What was the last part?

A. The more generous I am in assuming that the applicant pool would increase, the more it helped the race-neutral alternatives look good and attain the actuals. So I tried to be generous with regard to those assumptions.

Q. Thank you.

That wasn't really my question, though. My question was more specific to modeling.

You didn't actually do any statistical modeling to predict how the applicant pool would change, did you?

A. I wouldn't call it modeling. I would call it looking at data to try to understand what was likely to be the reasonable percentage of the well-qualified applicant pool.

Q. Thank you.

Under the -- strike that.

By your reasoning, wouldn't disadvantaged students be more likely to apply in a system -- a race-neutral system involving SES status?

A. Yes. If low SES status meant that a student was

significantly more likely to be admitted to UNC, I would expect that a disadvantaged student, who is classified as a disadvantaged student here, would be more likely to apply, yes.

Q. And that would include disadvantaged URM students, correct?

A. Yes.

Q. All right. Let's look at your Slide 33.

A. I have it in front of me, Mr. McCarthy.

Q. Thank you.

You conducted some simulations of race-neutral alternatives using SES status, correct?

A. Yes.

Q. And in this one, if I have this right, you modeled admissions based on a socioeconomic index, correct?

A. Yes, a socioeconomic index that's based on the logic of disadvantaged four-year college enrollment classes.

Q. And this figure here -- this slide is based on Exhibit 9, Figure 1, from your opening report, correct?

I'm reading that from --

A. Oh, yes, I can see that in the --

Q. Go ahead.

A. I can see it in the footnote.

Q. Yeah, I just was reading that from the bottom left footnote there.

A. Thank you.

Q. And as I understand it, you focused only on what you call

the disadvantaged stage of the process, and you do not actually complete the class, correct?

A. Well, I do complete the class, but this chart does not show the completion of the class. It only has a note in the upper left-hand quadrant that explains what happens to the simulation when the class gets completed. It's just that there's no way to show that stage very easily on this chart.

Q. Okay. Let's set that issue aside for a moment, and let's look at this disadvantaged stage.

You explained earlier how you ran 20 different versions of this model with your socioeconomic index, correct?

A. That's right.

Q. And those 20 different versions vary along two factors, correct?

A. Yes, emphasis and threshold.

Q. And I get those mixed up sometimes, but I believe that emphasis means the number of seats reserved for disadvantaged students, correct?

A. That's correct, yes.

Q. And by threshold, I think you mean the depth on the socioeconomic index that you go into in pulling students from, correct?

A. That's right; how disadvantaged a student has to be before the student is considered to be socioeconomically disadvantaged.

Q. Thank you.

And this slide is a scatter plot of how those 20 different versions of your simulation perform in terms of average SAT score and the number of URM students, correct?

A. Yes.

Q. And the dotted vertical line shows the number of URM students in the actual class, correct?

A. The dotted vertical line, yes, it does.

Q. And the dotted horizontal line shows the average SAT score of those actual URM admits, correct?

A. Yes, it does.

Q. So then the green dot at the intersection of the two dotted lines represents the actual class in terms of both number of URM admits and average SAT score, correct?

A. That's right; the green dot represents the actuals on both of those dimensions.

Q. Thank you.

So taking the blue dot on the bottom right as an example, I just want to make sure I understand what we're dealing with here. That dot represents your simulation where you reserve 1,500 seats for disadvantaged students and pull only from the bottom 5 percent on the SES index, correct?

A. Yes, that's exactly right.

Q. Okay. And the scatter plot -- where that is on the scatter plot, I should say, shows that that simulation actually brings

in a much higher number of URM students than the actual class, correct?
A. Certainly the number of URM students rises, and it -- without knowing the exact numbers off the top of my head, it looks like it rises by a little under 200 students.
Q. And at the same time, it does -- it's much lower in terms of the average test score, correct?
A. Right, the average test scores are falling from over 1200. We know that average test scores at UNC for URM students are over 1200, and they fall to about 900.
Q. Got it.
And then if we look over to the top left, the blue dot all the way up at the top left represents your simulation where you reserve 750 seats for disadvantaged students and pull from the bottom 25 percent of the SES index, correct?
A. Yes, that's correct. So the emphasis is smaller, and the threshold is higher.
Q. Thank you.
A. Sorry -- yes, I said it correctly. Thank you.
Q. I think you did. I'm not going to use those terms, though, if that's okay with you, because I will get them screwed up and make this worse.
And I believe your position, when you were discussing this with Ms. Flath earlier, was that this simulation with your socioeconomic index doesn't work out because none of the 20

versions you ran meets both the number of URMs and the average SAT score of the actual class, correct?

A. Yes, that's correct.

Q. Okay. So something else here is interesting to me. If you look at all the blue dots that denote reserving 750 seats for disadvantaged students, they roughly make a diagonal line on the left side of all the dots, correct?

A. Yes, that's correct.

MR. MCCARTHY: And, Mr. Lawrence, can you switch over to X7. We may switch back to this one in a minute, so keep 33 lying around.

Q. (By Mr. McCarthy) So you can see where that yellow line is, the 750?

A. Well, I can't see the yellow line, but I believe that it was given to me in the handouts, so I can find it.

Q. Yes. I'm sorry. Let me give you a minute to look for it. This would be in the -- you should have a set of demonstratives. I think there's nine of them, and it's the seventh one out of the nine. Sorry about that. I'm a little slow with technology today. I appreciate counsel for looking out for me over here, even if they did try to slide in a thousand simulations.

A. I think we are looking at the same page now, Mr. McCarthy, because I can see a yellow line with 750.

Q. Just to make sure, because there are a few, there should be

a little 7 in the bottom right corner and that would make sure we're on the same --

A. Yes.

Q. Great. Thank you.

So if we look -- again, just to back up a second, the blue dots that denote reserving 750 seats for disadvantaged students, they make roughly that yellow diagonal line. And if we do the same thing with the blue dots that denote reserving 1,000 seats for disadvantaged students, that's that orange line there with the 1,000. The same thing with the 1,250-seat simulations, they make that darker orange line. And then for the versions of this simulation reserving 1,500 seats for disadvantaged students, it makes what looks like that red diagonal line there.

Do you see that?

A. Yes, absolutely.

Q. Okay. Let's go back, now that we have that in mind, to Slide 33.

A. Would it be helpful if I explained why we expect them to make diagonal lines?

Q. No, that's okay. We'll talk about it here. I'll probably ask you some questions about it.

A. Okay.

Q. So what we also notice is that these dots -- like, if we look at the dots denoting 750 seats, so, again, the ones that

were on that yellow line, they go up on the scatter plot as the percent depth on the SES index increases, correct?
A. Yes.
Q. So the 750-seat, 5 percent simulation is at what looks like a little over 1000 on the average SAT score, correct?
A. That's right.
Q. And as that percent depth rises to 10 percent and then 15 percent, then to 20 percent and 25 percent, those versions of your simulation get higher and higher average SAT scores, correct?
A. Absolutely, yes.
Q. So the 750-seat, 25 percent version of your simulation nearly matches the average SAT score of the actual class, correct?
A. Yes, although it has many fewer URM students.
Q. Understood.
But had you gone further into that SES index, say to 30 percent or higher, it appears highly likely that you'd surpass the average SAT score of the actual class, correct?
A. Yes. In fact, if we were to project that yellow line that you drew on the other chart, it would sort of keep following that yellow line, so it would keep going up and to the left. So we would keep losing URM students and keep gaining on SAT scores.
Q. Thank you.

And let's now look where we saw that first orange line. If we move to the right of it from the 750-seat line and look at the blue dots reserving 1,000 for disadvantaged students, that's when we moved over a little bit to the right to that orange line, correct?

A. That's correct, yes.

Q. It's as if we took our diagonal line and shifted rightward, correct?

A. That's correct.

Q. And they exhibit the same pattern that we saw on the 750 line, whereby an increase in the percent depth on the SES index corresponds to an increase in average SAT score, correct?

A. Yes, because the students are less socioeconomically disadvantaged, so you're able to find more who have high test scores and grades.

Q. Precisely.

And if you move rightward again to the blue dots that made that darker orange line we saw before reserving 1,250 seats for disadvantaged students, that's over a little further to the right, correct?

A. Yes, that is.

Q. And the 1,500-seat line moves over to the right even a little bit more, correct?

A. Yes, that's correct.

Q. And you could imagine that a 1,750-seat line would move

even further to the right in the direction of more URM admits, correct?
A. Yes, because SES is controlling more and more of the admissions of the class.
Q. Exactly. So there are two distinct patterns exhibited here. First, increasing the number of seats reserved for disadvantaged students increases the number of URM students in the simulation, correct?
A. Yes, because you're shifting to the right as you reserve more and more seats for socioeconomically disadvantaged students.
Q. Exactly. And, second, increasing the depth on the SES index steadily increases the average SAT score of those URM students, correct?
A. I think when you say "the depth on the SES index," what you mean is that students who are more and more middle class or upper middle class are being considered to be low SES. That's what you mean by the depth on the SES index. That's what we're doing as we move to a higher and higher percentage.
Q. Yes. I'm not trying to mix anybody up. We're rising up from the bottom. So when we have 5 percent, it's the bottom 5 percent; and when it's 10 percent, it's the bottom 10 percent; and when it's 25 percent, it's the bottom core tile, right?
A. Correct, uh-huh.

Q. One would imagine a 2,000-seat, 50 percent model would likely look very promising and might even exceed the actuals in one or both dimensions, correct?

A. Well, the answer is yes and no. So let me tell you first the yes part, and then let me tell you the no part. Okay.

The yes part is that if we were to keep assuming that UNC practiced admission according to the way that's simulated here, and we actually said they're going to do this, then we -- if we keep shifting further and further to the right, then -- for instance, if it was 2,000 seats or 2,500 seats, or something like that, we might be able to attain the actuals, but the reason you would be able to -- so that was the yes part.

Here's the no part. UNC does not actually admit students in rank order in terms of their test score, whereas that is what I was doing in this disadvantaged stage. So the reason why it would be -- the reason why you might think, oh, that looks terrific, 2,500 seats is going to be better than attaining the actuals is because you've thrown out UNC's actual holistic admissions process and just substituted admitting the top test-scoring student in the state, the next test-scoring -- top test-scoring student and onwards down through the top 2,000 or 2,500 students.

So it -- you might say to yourself, Wow, I can attain the actuals better than the holistic admissions process, but it's really simply because you've given up on doing holistic

admissions at all, and you're just using a test score standard to admit a lot of the total students in class.

So, yeah, it is possible, but it would be -- it would be very deceptive because that's -- that's not really the way UNC is going to do admissions, or if it is, it should just admit students strictly on SAT scores now.

And then we need to look -- we would need to compare this disadvantaged stage to what it could achieve, if it's simply admitted students based on SAT scores right now, just starting with the top-ranked student in North Carolina and going on down. So in that case, the actuals would be different too, because we would have thrown out the current admissions process and so the actuals would have to change too. So we're not -- you can't compare to the actuals now, which are produced by a holistic admissions process, and then say, Oh, we would be able to hit those with this test score-only model, because you would have to now compare to a new set of actuals that would be based on the test score-only admissions models, which I could model for you because I do show in my opening report, for at least one of the simulations, what happens as you just throw out the holistic admissions process and go to a higher test-scoring, grade-only process. You can see that UNC would have quite different actuals.

Q. So I have a couple questions. One, the hypothetical I proposed to you was a 2,000-seat model -- a 2,000-seat,

50 percent model.
A. Sure.
Q. And you said that that would just throw out holistic admissions. But that wouldn't throw out holistic admissions, would it?
A. It wouldn't entirely throw out holistic admissions, but we would still need to recompute the actuals to allow 2,000 seats with 50 percent cutoff in terms of SES to be placed purely by test scores. And so we would need to change what the counter -- what the actuals were. I don't want to say change the actuals because that sounds a little odd, but we need to change what the counterfactual is because the holistic admissions process would only apply to part of the admissions pool, and the rest of the admissions pool would be admitted strictly on the basis of test scores. So if we're going to have a relevant comparison, we actually need to do that with those 2,000 seats, you know, without the SES plan put in place, because we -- you have to try to make an apples-to-apples comparison. That's really important. You can't just jump around between -- we can't just -- we can't just jump around. We do have to try to make comparisons that are relevant and realistic.
Q. So I want to get back to that. We can -- there's a couple topics there. One is the changing of the actuals, and I want to talk about that in a minute. But the 2,000-seat, 50 percent

model based off of your simulations -- your simulations are talking about 400 seats total in this operation, right? I believe that's what you explained, and I think that this is in the -- I'm sorry. Like you, I've got a lot of binders with a lot of reports.

(Pause in the proceedings.)

Q. Well, I will confirm this shortly, but I believe that you were talking about in this stage having 4,000 available seats and setting aside a certain number, which I think is the emphasis number in these simulations. Okay.

So in that system, if you have a 2,000-seat, 50 percent model, that would be looking to fill up half of that group with disadvantaged students, correct?

A. Yes, but I think that's before -- we have to think about two things that are going on. The first is that we're trying to fill up the seats with socioeconomically disadvantaged students. And the second, that in this disadvantaged stage, we are admitting the students purely based on test scores. Let's just try to break it down for a second.

Let's say that UNC -- forget about SES for a moment. Just set it to one side. Let's say that UNC took its current admissions plan and threw out half of it, so it was going to practice holistic admissions on half of the incoming class, and it was going to just take the other 2,000 seats and just rank students according to their SAT scores in the state of

North Carolina and admit them. Okay. That would be the comparison against which we need to now base the SES on, because what we're saying is two things have happened when we move to an SES plan: We both set aside a certain number, as I explained UNC could do, and we decided to admit students purely based on their test scores, so within that group who are classified socioeconomically disadvantaged.

So when we compare with the before and after the introduction of the race-neutral plan, we need to take account of the fact that UNC would have thrown out half of its holistic admissions process and purely be admitting students based on test scores. So, of course, UNC's average test scores would go up because it would only be admitting on test scores for 50 percent of that.

Q. And so you are talking about adjusting the actuals to a different actual, right?

A. I'm talking about adjusting the actuals so that when we make a comparison between the actuals and the alternative, we are kind of doing an apples-to-apples comparison to the extent that is reasonable.

Q. Okay. So we wouldn't be then comparing to the status quo. You would be picking some other baseline that's not the status quo, and that's what you want to measure and compare it to, correct?

A. In -- yes, if you've got a big enough number of seats -- if

you have a smaller number of seats, say 750, it's not as important to do that kind of -- we can call it an adjustment, but if you get a larger and larger number of seats, say half of the admissions pool, or something like that, then it's very important that you be realistic about what happens when you admit half of the students based purely on their test scores. In fact, in my opening report, I show an example of doing this for one of the -- one of the simulations. I believe it's one of the geography-based simulations.

Q. I think it's -- I think it's Exhibit 13, Table 1, maybe. This would be -- there's no page numbers, unfortunately, in the appendices. And I'm not blaming you for that because I think our experts did the same thing, but it makes it difficult sometimes.

(Discussion between counsel.)

A. Yes, that's right, Mr. McCarthy, Exhibit 13, Table 1.

Q. Okay. And I think you're talking about the middle panel, if you will, correct?

A. Yes, that's correct. So I believe that what we did to construct this middle panel was we looked at who the UNC North Carolina resident public school admitted student would be if we went to a situation in which only GPAs and SATs were used in admitting students. So you can see that you get higher SAT scores in the middle panel as opposed to the left panel where we're looking at the actuals or the holistic admissions

process.

For instance, the average SAT scores of African Americans that's shown in the very first row rises from 1214 to 1302. Roughly about (indiscernible).

(Court reporter requests clarification.)

Q. I think you said that the African American average SAT score goes from 1214 up to 13,202 -- I'm sorry -- 1302?

A. 1302, a rise of about 100 points, because in the middle panel these African American students are being admitted purely based on test scores and grades. Although, to be clear -- to be clear, it is half grades at this point. It is not all test score. If, instead, I had shown a middle panel where we were admitting students based purely on test score, no grades considered, then the African American students' test scores and, indeed, the test scores of all the other groups would have risen by even more because I would be putting more and more weight on only the test scores and admitting them on grade.

I think that's the point I was trying to make about that sort of chart that we were looking at with the actuals in green.

Q. So let me make sure I have this right. So on the chart we are looking at with the actual in green and the scatter plot, when I proposed a hypothetical of a 2,000 seat -- a 2,000-seat, 50 percent SES model, you suggested that the better thing to compare it to, instead of the actual class at UNC, would be

something like this middle panel here on Exhibit 13, Table 1, correct?

A. Well, it would be more like the middle panel, but it would not be the middle panel because in the middle panel I'm still giving 50 percent of the weight in admissions to GPA and only 50 percent of the weight to test scores, whereas in the diagram with the little green dot in the middle, I am admitting students from the disadvantaged pool entirely based on test scores.

So I would have to create a new sort of middle panel here, one that was based entirely on test scores, and the test scores would be even higher. Although, as you said, Mr. McCarthy, it would only be half of the class that was admitted based totally on test scores, so I could fill up the rest of the class with the holistic admissions process.

Q. Okay. But just to make sure -- there's a lot going on here. Just to make sure I understand, you would want to compare that hypothetical 2,000-seat, 50 percent simulation to this middle panel here on 13, Table 1?

A. Well, no, not this middle panel, but it would be in the direction of this middle panel. What I would have to do is prepare a new panel in which 50 percent of the students at UNC were admitted strictly based on test scores, going from the highest scoring student in North Carolina on down until I filled up my 2,000 seats, strictly based on test scores. And

as I think I tried to say, this middle panel, in fact, weights grades and test scores equally, so test scores are not going to be as high in this middle panel as they would be if I admitted students strictly based on test scores.

Q. Okay.

A. I don't think I prepared such a middle panel because I didn't know I would be asked, but I certainly would be glad to prepare it, and I note that it would go -- the test scores would be even higher than the ones that we are examining in this table, just as a logical matter.

Q. Okay. So it would be something sort of coming off of that middle panel but not quite the same thing, and you think it would have higher SAT scores?

A. It would certainly have higher SAT scores, yes.

Q. I'll direct you to that same panel. If this is the one that is going to be our benchmark or a benchmark that looks something like this, and that's going to be what we compare to as our actuals, then we would want to compare it to the actuals on underrepresented minority representation too, wouldn't we, where there African American is 3.5 percent and Hispanic is 3.4 percent?

A. Yes, if we admit -- if we admitted students -- I think we've talked about this before. If we admitted students based strictly on just using this kind of index of GPA and test scores, we would end up with a different racial composition.

Q. Right. It would be much lower, wouldn't it? This suggests it would be substantially lower.
A. Yes.
Q. So that's what you want to use as the status quo if we evaluate something like a 2,000 seat, 50 percent SES index simulation?
A. Well, as I said, Mr. McCarthy, I didn't actually -- I didn't actually do that exercise, so I don't know how that exercise would turn out. Instead, I tried to focus on the actuals that UNC actually achieves through its holistic admissions process, and I thought that that was a good comparison because, one, it's something that we all sort of understand. It isn't -- it isn't arrived at by some artificial process that doesn't exist. And, furthermore, it's not enough of a holistic admissions process was thrown out for me to think I can't learn anything from those comparisons between the race-neutral alternatives and the actuals. I still think I can learn a lot from those comparisons.
Q. So before you mentioned that you wanted to use that middle panel on 13, Table 1, as a benchmark, whereas a new actual -- or use something like that, but it sounds now like you're saying, no, you want to stick with the status quo that we were talking about before, the actual green dot?
A. So the actuals that UNC attains are -- are the green dot. I think that's very important for us to keep in mind what those

actuals are. Those are attained by the admissions process.

I think when you are considering switching an admissions process -- for instance, here in the Exhibit 13 and all of the different tables what I'm trying to do is help us understand what a geography-based plan might achieve. So I think -- and under those geography-based plans, we are forced to switch to an admissions process that necessarily gives all the weight or almost all of the weight to test scores and grades. So we do need to think about what that switch does by itself before we decide to use the geography-based plan.

So it's just a matter of trying to compare apples to apples, but, no, I do not think that anyone has suggested to me it would be a good idea to simply throw out the holistic admissions plan or throw out holistic admissions altogether at UNC and substitute for it a plan that's purely based on test scores, or something like that.

Q. Okay. So I think we're going to -- I guess we're sticking with the actuals as the actuals.

But let's go back to the 2,000-seat, 50 percent index that we were discussing before. Again, that wouldn't throw out holistic admissions, would it? It would still allow for, at least under your simulation, half of the class to be filled by holistic admissions and half of the class to be filled by your SES index-based system, correct?

A. Right. So if we say that half is going to be filled by

holistic admissions and half is going to be filled in this other way, then, again, we have to first take account of the fact that the half would be filled in this other way, would be filled solely based on test scores. So we have to use that as the relative comparison for when we introduce the race-neutral SES-based index.

We have to make sure that we start off with those 2,000 seats, say they are going to be filled entirely based on test scores, and then see what happens to those 2,000 seats as we impose that SES race-neutral alternative. So we're just trying to be fair, do apples to apples, to the extent we possibly can, yes.

Q. So --

A. I think that -- go ahead.

Q. Go ahead. No, please. Sorry.

A. As I said, I think this doesn't matter that much when we're only talking about 750 seats; but once we start to get up to half of the admissions process, we really have to start to do the right thing here and think very carefully through each one of these steps so that we're making the relative comparisons and we're not making claims that are not, in fact, productive and true.

Q. So I want to get at that. So you want to compare the half of the class that's filled by your SES index to sort of a half of a class that's filled by test scores, correct?

A. Correct, yes.
Q. Okay. So that's the -- we'd be calling this the disadvantaged stage, right, since it's just a disadvantaged stage for 2,000 seats, correct?
A. It would be a disadvantaged stage for 2,000 seats. And before we impose the race-neutral alternative and try to allocate those seats to disadvantaged students, we would have just been allocating them to students in North Carolina purely based on test scores. So I wouldn't call that a disadvantaged stage.
Let me just say we have 2,000 seats you've already set aside on the basis of test scores. Now we decide that we're also going to impose with those 2,000 seats -- we need to go to students who we consider to be disadvantaged, but we're still going to assign them purely based on test scores. So that's the apple-to-apples comparison.
Q. So the apples-to-apples comparison, you're going to -- and I know this is unusual, but you're going to change the status quo for that portion of the class, for this disadvantaged stage, and move the green dot up higher on the y-axis that represented average SAT score, correct?
A. It would certainly be higher on that axis and not -- I don't actually know exactly what happened (indiscernible).
(Court reporter requests clarification.)
Q. I think -- I don't want to put words in your mouth, but I

think you were saying that it would go up in terms of the SAT score on the y-axis, that green dot, but you don't know how much because you hadn't actually looked into it?

A. It would change in terms of racial and ethnic diversity. I don't know what that would look like.

Q. So --

A. I do know --

Q. Go ahead. Sorry.

So the SAT score would go up, and it would change in terms of racial or ethnic diversity and table -- or Exhibit 13, Table 1, shows us that. That's that model that you did of purely test scores, and we can see what happens there. Test scores go up dramatically and URM representation goes down dramatically.

So if we're going to use something sort of like that as our benchmark for the disadvantaged stage when evaluating a hypothetical plan of 2,000 seats and 50 percent SES index, then that green dot, if we go back to Slide 33, is going to move up quite a bit, and it's going to move to the left quite a bit, correct?

A. I don't know exactly what it would do with race and ethnicity because that's not obvious.

But what I -- I think that -- I think that what we're missing here a little bit is a reminder of the fact that, as I discussed this morning with Ms. Flath, when I consider the race-neutral alternatives, I make assumptions that are

deliberately quite favorable for the race-neutral alternatives. And one of those assumptions, and a key one I discussed this morning, is that the student in the disadvantaged stage are admitted based on their test scores. This favors the race-neutral alternative relative to the actuals because it naturally means that I'm admitting more students who are high test scoring. And we discussed that this morning.

So, yes, if you want to exaggerate that kind of assumption that I made and exaggerate it and exaggerate it and exaggerate it and exaggerate it, then, of course you're going to get a kind of high-scoring class that looks very different, but that's merely taking an assumption that was meant to sort of test a reasonable ceiling and then blowing it up to an extent that is -- it's a little -- it's a little beyond what anyone would consider to be reasonable, I guess, and also totally changes the nature of what we should be looking at as a comparison.

Q. So let's go back to Exhibit 13, Table 1. You said you weren't sure what would happen in terms of racial diversity, but you did tell us before that if we moved towards that sort of a plan, you knew the SAT scores would go up quite a bit. And I think the answers are actually somewhat clear or point in a sharp direction if we look at these panels here on 13-1.

In the actuals, the percent of admitted students who are URM is 8.8 percent African American and 5.9 percent Hispanic.

And when we move over to the panel that you're talking about that you want to use as the benchmark, African American admitted students drop to 3.5 percent and Hispanic drop to 3.4 percent.

Now, I'm not advocating for this to be the comparative benchmark, but you are, Dr. Hoxby, and you're telling me that you know the SAT scores are going to go up a lot, but then you say you're unsure what's going to happen with the URM diversity levels. But if you know the one, then you know the other. You're using these same tables to show the one. They're obviously pointing in just as sharp a direction on the other one.

So, again, I'm not advocating for the status quo, but if you want to compare your SES index to a different benchmark than UNC's actual actuals, then I think you have to fairly take what you're pointing to as your status quo.

A. Okay. So this middle panel is not based on admitting students based on test scores. It's half test scores and half GPA. You may be correct in your supposition that a percentage of students who are URMs would fall if we switched to an entirely test score-based system. I don't know whether that's true or not, but I'm not declaring that I think your supposition is wrong.

Q. Okay. Let's get back to the -- another point that we've talked about a little bit about getting rid of holistic

admissions, I think you called it; if we increase the number of seats, that is the emphasis to 2,000, there are schools --

A. Mr. McCarthy --

Q. I'm sorry?

A. I'm sorry. Mr. McCarthy, do you think I could just take a five-minute break?

Q. Dr. Hoxby, it's fine with me, if it's fine with the Court.

THE COURT: We can do that, ma'am. Let's take a five-minute recess. We will return in five minutes.

THE WITNESS: Just a break for all of my coffee.

THE COURT: That's fine.

(An afternoon recess was taken from 4:33 p.m. until 4:40 p.m.; all parties present.)

THE COURT: So I understand that you have about 20 minutes or so, and that you would come to a natural stopping place?

MR. MCCARTHY: Yes, Your Honor, I think about 20 or 30 minutes I'll be at a natural stopping point.

THE COURT: No more than 30. Thank you.

MR. MCCARTHY: Yep.

THE COURT: You may proceed.

MR. MCCARTHY: You've got it.

Q. (By Mr. McCarthy) Dr. Hoxby, I want to get back to this hypothetical 2,000-seat, 50 percent SES index plan. I understand that that would displace half of UNC's current

admissions process under your simulations, correct?
A. Yes, it would displace half of the admissions process.
Q. There are -- there are schools that have displaced portions of their admissions process with a race-neutral alternative, aren't there; for example, the University of Texas?
A. Yes, so the University of Texas and Texas A&M use the 10 percent plan.
Q. And the University of Texas, for example, uses an admissions process that's not that dissimilar from UNC for the remainder of its class, correct?
A. Yes, at this point. In recent years, University of Texas has been permitted to reserve a certain portion of its class, a quite small portion, I believe about 10 of its class -- it's approximately 10, but I have not checked those numbers recently. It is allowed to reserve a small percentage of its class to admit using a more holistic process and not using the top 10 percent plan.
Q. So a hybrid sort of plan is a feasible plan, theoretically, correct?
A. Yes.
Q. So there's nothing about a 2,000-seat, 50 percent model that is just off the table in terms of its theoretical possibility, correct?
A. Well, yes, but I wish to remind you that this is not very similar to the Texas 10 percent plan. This would be a plan

where 50 percent of UNC's admission would be based strictly on -- strictly on test scores.

Q. Understood.

Let's turn to your Slide 34. This is a -- I'll wait for you. Sorry.

Do you have Slide 34, Dr. Hoxby?

A. I have it in front of me, yes. Thank you.

Q. Great. Thank you.

This is a similar type of scatter plot analysis as the one we were looking at before on Slide 33, but this one is using your race-predicting index, correct?

A. Yes, it is.

Q. And this is based on Exhibit 9, Figure 7, from your opening report, correct?

A. Yes, it is.

Q. Now, the first thing I notice when I look at this scatter plot is that there are many more versions of your race-predicted index simulation showing promise in terms of both the number of URM admits and the average SAT score of those URM admits.

Do you see that too?

A. What I was asked to evaluate was whether a -- whether a race-neutral plan could attain the actuals of UNC under very optimistic assumptions that were very generous to the race-neutral plan. You can see that I'm never able to attain

those actuals here.

And may you also remember, Mr. McCarthy, that this race-predicting index is not actually, strictly speaking, race neutral, but is designed to sort of test the limits of what could possibly be achieved by UNC using SES variables and that, in fact, UNC would have to use race in order to create a race-predicting index.

So, in fact, although this is designed to be sort of testing the limits to show what you could possibly do, it really couldn't be a race-neutral process because they would have had to just use race.

Q. So I understand. And I understand you've characterized that as an effort to find the ceiling, right?

A. Find the ceiling, test the limits, show the -- you know, the absolute most that a race-neutral socioeconomic plan could do. It's not realistic, though, because it's not actually race neutral.

Q. I understand your qualifications on it, that it's intended to be looking for a ceiling, and you view it as just that only. But I still want to look at these numbers here. And if we think about the hypothetical 2,000-seat, 50 percent version I talked about before when we were discussing it in the context of your previous slide, if we look at that here, right, if we look at the same kind of trend lines that we have along the first of the 750 blue dots, and then as we move to the right,

the 1,000 blue dots and then the 1,250-seat blue dots and then the 1,500, it's the same trend lines we saw before in that as you increase the number of seats, that is, the emphasis, it moves to the right more and more and gets more and more URM students. At the same time, as you move up and take a higher percentage of people from the SES index, you're going to get higher and higher SAT scores.

So if you did a 2,000-seat, 50 percent kind of model, you'd be very likely to beat the actual class in terms of both the number of URM students and the average test score of those URM students, correct?

A. No, that's not correct.

So let's go back to the point that when we decide to throw out half of the UNC process that is holistic and replace it with test scores only, we need to adjust what we would think of as the actual.

I'm going to take your supposition, Mr. McCarthy, as being maybe true. Let's say that we move to a test-score-only model for half of the class. We would expect that green dot to move upwards because test scores would be higher, in all probability. That's very, very likely. And I'm also going to take your supposition, although I did not say I advocate for it, that the little green dot would also move to the left because there would be fewer URMs. I think that was what you were trying to do -- to say before.

Q. Yes, that was the line for inclusion in the table.
A. Okay. So we've moved the green dot up and pretty far to the left. I think is what you were trying to suggest might happen. Let's just take that as a hypothetical. Okay. So now as I start to move from 1,500 to 2,000-seat to 2,500 seats, you're right, but what would be happening is we would expect that those sort of diagonal lines would be moving to the right sort of to the -- I call it the northeast -- would be moving to the northeast, but since the green dot would have moved to the northwest, we would still not necessarily -- that would change where that nice quadrant was, okay, because the green dot would define a new quadrant, and so we might still not hit that quadrant.

In fact, the likelihood in a situation like that is that we would have a lot of trouble hitting that quadrant because the test score -- test scores that we would be trying to attain for UNC would be so high that we would never get in that quadrant with the 2,000 seats, with the 2,500 seats, or whatever.

I haven't actually done that exercise, but I think it is reasonable to think about the patterns that you're describing and try to understand how they would probably play out, understanding that I have not actually calculated those numbers.

So -- and you can't just do it off the -- I mean, it's not possible to do it off the top of your head, and let me explain

why. The reason is that it's not just that these patterns aren't necessarily going to play out in exactly the same way as we increase the number of seats more and more because you have to realize that we're digging into different and different parts of the potential applicant pool in the state of North Carolina, and we actually need to look at the data and run the numbers. Because if it were just a matter of "I can draw patterns and they're always going to turn out the same way," I would not need to have done all of this very difficult work in socioeconomic modeling.

Q. I understand.

So if -- looking at this scatter plot, if we increase the emphasis and the threshold to something like 2,000 and 50 percent, it looks like it would probably hit that green dot that's the actual class.

Now, I understand your point is that if we use this other status quo that looks something like Exhibit 13, Table 1, that's up higher to the left, we don't really know, correct?

A. Yeah, we don't know whether we would ever be able to hit what we might call the new green dot.

Q. Okay. So it might hit it; it might not hit it; and it's hard to guess from where we are, correct?

A. Yes, because under this -- under this different scenario, UNC would be a very high-scoring school, but it would be very racially undiverse under your supposition. So we would have to

actually figure out the numbers there.

I think it's also important to understand that UNC cannot -- remember, my assumptions were very positive towards the race-neutral alternatives, so I assumed that a lot of students apply under this race-neutral alternative and that they not only get in, but that a lot of them matriculate.

So in this world in which we're getting half of the class purely based on their test scores, that we really have to think hard about would all of the high school students in the state of North Carolina be applying? Would they be equally likely to apply? Would they want to matriculate?

I think you have to look at the data to know the answers to those questions, and I tried to look at realistic models, whereas I would describe that as so unrealistic that I'm not sure I could opine very much on a world like that because it would be a world in which there was a lot of leaps of faith and some of them were really big leaps.

Q. So you just mentioned, you know, one of the reasons why we don't know is because of things like not knowing what would happen with matriculants, but you actually did this same model as Exhibit 9, Figure 7, that underlies this scatter plot. And that's Exhibit 9, Figure 8, in your opening report, correct?

A. Absolutely, for matriculants.

Q. Right.

A. Should I pull that up?

Q. Yes, please. Let's do. So this is your opening report Exhibit 9, Figure 8.
A. Do you mean Exhibit 13 or exhibit --
Q. I mean Exhibit 9, Figure 8. We were just -- and this in your opening report. We were just looking at your Slide 34, which was based off of Exhibit 9, Figure 7. And you mentioned about matriculants, so I wanted to look over at Exhibit 9, Figure 8, which is the same --
A. Sure.
Q. -- race-predicted index but with matriculants, correct?
A. Yes.
Q. So do you have it in front of you now?
A. I do have it in front of me.
Q. Great. So we have -- and I'll try to make this quick because I know we're getting at the end of everybody's day here, but we have the same trend lines happening as in the last couple of simulations we looked at: The 750 line, the 1,000-seat line, the 1,250-seat line, and the 1,500-seat line. And this one looks even more promising once we go with matriculants. In fact, there's a couple that are right near the actual status quo green dot. And if we move to a 2,000-seat, 50 percent plan, we'd surely pass that green dot.
Now, the -- let -- and I know that we might have a conversation about whether we move the green dot. But if we just look at this green dot, the one that's the actual class

right there on Exhibit 9, Figure 8, you would agree with me, wouldn't you, that a 2,000-seat, 50 percent version of this plan would likely exceed both dimensions of the actual class?
A. I'm going to agree with you and disagree with you. The part where I agree with you is that I think you are correctly discerning the pattern by which -- if we set aside more and more seats for disadvantaged students and raise and raise the level of socioeconomic status that we consider to be disadvantaged, we are going to see that the dots tend to move in the northeast direction.

But I'm going to disagree with you that when you take that to such an extreme that we should be considering things relative to this green dot. You can say I must take this green dot, but I don't think I have to take the green dot if it no longer makes sense as a comparison. I think it is my obligation as a serious analyst to try to make comparisons from which people can learn the truth, and I think that that would be deliberately misleading someone.
Q. It's fine with me if you want to move the green dot. I just wanted to set a baseline here, that if we keep that green dot, we would both agree that moving to a 2,000-seat, 50 percent plan would surpass the green dot in both dimensions, correct?
A. I think I've answered that question numerous times. Do you want me to answer it again the same way?

Q. No, that's okay. So --
A. I'm very glad to answer it as many times as you like. I have no problem with that. I am not running out of patience or anything. I'm just saying I think I've already answered that question.
Q. I understand you answered it. It wasn't clear to me where you were on that, and I wasn't trying to force you to be stuck with that actual class. I just wanted to understand if that's our actual class, and I -- we'll talk about the moving of the dot in a second.

But if that's our actual class, a 2,000-seat, 50 percent plan pretty clearly beats it in both dimensions, correct?
A. The conditionality in your question is problematic for me because you keep saying "if that's our actual class" when, in fact, I know that in such -- under the circumstances you're asking me to consider, that would not be very close to being the actual class at all. So it's very difficult to answer a question where the condition being set in the first half of the question doesn't align very well with the conclusion that's being drawn.

So you're trying to condition on one thing and then draw a conclusion, and with the condition that you set out first, the conclusion would be unwarranted. So, right, I'm trying to work with you here, but I think I have tried to answer this question.

Q. Okay. I understand you don't like the condition, and that's fine. I know we've had some agreement and disagreement about that, which is fine too. But I think we know the answer under the condition.

So let's now take away the condition, okay, and we move the green dot in the way that you imaged before --

THE COURT: Mr. McCarthy, I have allowed you a lot of leverage here, but you're testifying. She's answering the question the way she feels like she needs to answer the question, but you're testifying, and that's not what we do on cross-examination. So I think you move on to your next question.

MR. MCCARTHY: Okay, Your Honor. I'm sorry about that. I was enjoying my dialogue with Dr. Hoxby. I like to talk with people who can agree and disagree with me sometimes.

THE COURT: Well, we can be here forever, and I'm sure she will dialogue with you at her convenience, but we need to move this along.

MR. MCCARTHY: I'll wrap it up shortly, Your Honor.

THE COURT: All right. Thank you.

MR. MCCARTHY: Sorry about that.

Q. (By Mr. McCarthy) So if we move the green dot in the manner you suggested, Dr. Hoxby, it's still possible that a 2,000-seat, 50 percent model might hit it, correct?

THE COURT: That's the question --

THE WITNESS: I just don't think I can answer that question --

THE COURT: Wait just a minute. Wait just a minute. That is the question I've asked you to move on from.

MR. MCCARTHY: I'm sorry, Your Honor.

THE COURT: Let's move on.

MR. MCCARTHY: Got it, Your Honor. I misunderstood your direction before. I thought you were talking -- never mind.

THE COURT: Yes.

MR. MCCARTHY: My fault.

Q. (By Mr. McCarthy) We previously agreed, Dr. Hoxby, that there's nothing theoretically impossible about a 2,000-seat, 50 percent SES index model, correct?

A. Yeah. There's certainly nothing theoretically impossible about it, no.

Q. And as of right now, we don't know where it would end up, correct?

A. Well, one would have to do data analysis. I think it's very important to look at the actual data for something like that.

Q. The trend lines point in certain directions, but we can't tell without the data analysis, right?

A. Yes, it's not enough that the trend lines just point in certain directions, because as we actually dig into student

data, the students who come up in the applicant pool aren't necessarily replicating the patterns of the students who showed up previously. The modeling just isn't that simple. I can give you some examples, if that would be helpful to you, so that you can help -- so that I can help you understand why it is that I think that we would really need to do the data analysis and not just -- not just look at the patterns.

Q. If it's not theoretically impossible and the trend lines were pointing in this direction, why didn't you consider this option before and do the data analysis?

A. Because I wanted to have some amount of realism. I would certainly be not disinclined to do an analysis with 2,000 students. I think, though, that the reason that it's not a terrific idea to do an analysis with 2,000 students who are admitted strictly based on test scores to UNC is that, as I mentioned earlier, the assumptions that were generous toward race-neutral alternatives start to become very -- I'm not quite sure what the right word is here, but leaps of faith become very big leaps.

Like, for instance, assuming that all the top-scoring students in North Carolina apply to UNC is a very generous assumption, and the more we rely on that very generous assumption, the more it seems like a big leap of faith. We keep believing that that would be true. It's kind of like saying that every top-scoring student in North Carolina --

those who could probably go to Duke, those who could go to Harvard, those who could go to Stanford and University of Chicago -- they're just going to keep applying to UNC under the race-neutral alternative. And that may -- that's a very big leap of faith, and we're starting to rely on that leap of faith too much.

So I tried to make assumptions that, as I said, were favorable while still staying within the realm of some amount -- so I can try to be favorable, but that doesn't mean I should try to be ridiculously pie in the sky. I think I still owe it to people to try to choose assumptions that are favorable -- are not so favorable that we're starting to make things up. I don't think that's my role as an expert. I think I need to be responsible to the data and to the truth.

MR. MCCARTHY: We can break there, Your Honor.

THE COURT: I think that's a good stopping point.

MR. MCCARTHY: And I apologize again for misunderstanding your direction.

THE COURT: How much longer do you believe that your examination of Dr. Hoxby will be tomorrow?

MR. MCCARTHY: Your Honor, I think it will probably be -- I think it will probably be around 90 minutes --

THE COURT: All right.

MR. MCCARTHY: -- something like that. We got through -- I basically got through a significant portion of it,

but I think it will be about 90 minutes. And I'll promise, Your Honor, that I'll do my best to work on it tonight and try to streamline it and do it as quickly as we can tomorrow.

THE COURT: Thank you.

Was there anything that you needed to say to me?

MS. FLATH: No, Your Honor. We just wanted to confirm on the time since Dr. Hoxby is on the West Coast.

THE COURT: We will resume in the morning at 9:30 a.m.

And I thank you, Dr. Hoxby, for being here, and hopefully we will get through with this in due time. I appreciate your being here.

THE WITNESS: Thank you very much.

THE COURT: Yes.

MR. MCCARTHY: Thank you, Dr. Hoxby.

THE COURT: Anything further before we recess today?

MR. FITZGERALD: No, Your Honor.

MR. MCCARTHY: No.

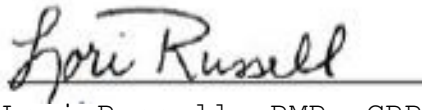
THE COURT: Let us recess court until -- adjourn court until 9:30 a.m.

(Proceedings recessed at 5:05 p.m.)

C E R T I F I C A T E

I, LORI RUSSELL, RMR, CRR, United States District Court Reporter for the Middle District of North Carolina, DO HEREBY CERTIFY:

That the foregoing is a true and correct transcript of the proceedings had in the within-entitled action; that I reported the same in stenotype to the best of my ability and thereafter reduced same to typewriting through the use of Computer-Aided Transcription.



Lori Russell, RMR, CRR Date: 12/15/2020
Official Court Reporter